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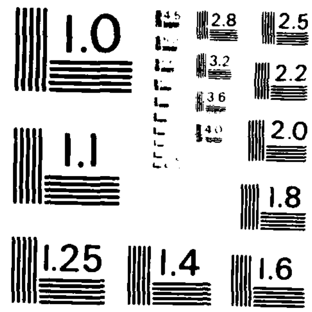

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NAVAL CIVIL ENGINEERING LABORATORY
Port Hueneme, California

Sponsored by
NAVAL FACILITIES ENGINEERING COMMAND

CONCEPTUAL DESIGNS FOR BERTHING PIER GALLERIES AND DECK LIGHTING

June 1983

An Investigation Conducted by
BROWN & ROOT DEVELOPMENT, INC.
P.O. Box 2002
Houston, Texas 77001

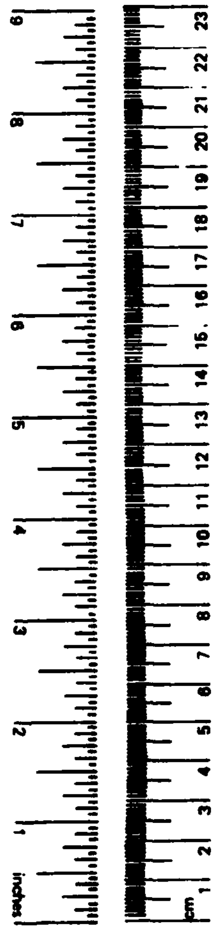
N62474-82-C-8303

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

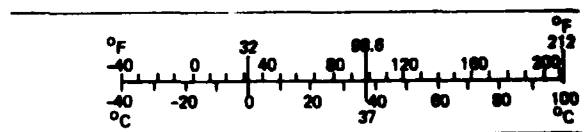
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1,000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number):

Preliminary designs are presented for utility galleries to be located below the top deck of new Navy surface combatant piers. The recommended concepts for both pile supported and floating piers are similar. Both concepts have openings for ship-to-shore utility line egress which are essentially continuous along the entire length of the structure. This continuous

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) access is a distinct advantage since it allows utility stations to be developed for new ship classes in the future without regard to pier opening constraints.

The recommended concepts utilize air-powered, fixed reels on the lower deck to both store and/or pay-out the electrical cables. This unique feature requires positioning of ship alongside the pier to match the electrical station, which can be easily accomplished by properly locating the mooring fittings along the pier.

An evaluation of numerous types of pier deck lighting systems was made, and it was concluded that light standards of moderate height supporting multiple-fixture arrays could be located on a pier with minimal interference with other activities. The recommended system achieves a minimum lighting level of 0.5 footcandles and can concentrate as much as 5.0 footcandles on high-tempo areas.

FOREWORD

The Navy requires new pier facilities to provide berthing for current and new ship types to be included in the planned 600-ship Navy. Ideas for innovative facilities will be provided as part of the Port Systems project. In addressing this requirement, the changing needs for pierside berthing of the new ship types must be considered. As part of this program, Brown & Root Development, Inc. (BARDI) was retained by the Naval Civil Engineering Laboratory (NCEL) at Port Hueneme, California to perform services under Contract No. N62474-82-C-8303, "Engineering Services for Navy Pier Facilities and Related Tasks" (BARDI Job No. XF-0025).

Task No. 1 of this contract for berthing pier utility services consisted of two subtasks:

> The first subtask, Berthing Pier Utility Gallery, required the conceptual development of two versions of a utility gallery to be located below the berthing pier's main deck, with one concept suitable for a fixed, open-pile platform pier (hereinafter called "pile-supported pier") design, and the second concept suitable for a floating pier design. The pile-supported pier concept was to use a closed, box-type design, while the floating pier concept would employ an open gallery for use where the tidal range does not cause constraints. The concepts were to be developed into preliminary definitive designs, identifying overall dimensions and showing the arrangement of mechanical and electrical services and connections, with areas for storage of cable and hose and access for maintenance and expansion. A simple shop fabrication design for a mock-up of a section of the closed gallery concept was required plus schematic drawings showing cable and hose connections in place from shore to ship.
>
> The second subtask, Berthing Pier Lighting, involved the investigation and development of requirements for suitable lighting intensity levels for berthing pier decks, and a preliminary definitive design for a lighting system to provide those levels with a minimum of components that interfere with other pier deck functions.

The results of these two subtasks are presented within this report in two separate sections.

A

ENGINEERING SERVICES FOR NAVY PIER FACILITIES
AND RELATED TASKS - TASK NO. 1

TABLE OF CONTENTS

TABLE OF CONTENTS
(Contd)

TABLES

SKETCH

DRAWINGS

APPENDICES

I. BERTHING PIER UTILITY GALLERY

(SUBTASK NO. 1)

This subtask required the development of conceptual designs for a utility gallery to be located on the lower deck of a two-level berthing pier structure. The design incorporates a plan for fulfilling the identified electrical and mechanical service requirements of the gallery. The concepts developed are forward-looking to accommodate the needs of ships projected for the fleet. They use new methods and provide for simplified future modifications.

1.0 CRITERIA

The basic criteria to be used for the study were provided by the Naval Civil Engineering Laboratory (NCEL) in the form of a Statement of Work and from further clarification during the Preliminary Conference held at NCEL (see Appendix C). In addition, NCEL provided considerable guidance material, much of which is listed in the Bibliography.

The ships to be considered in the study are given in Table I-1.

TABLE I-1
DESIGN SHIPS

TYPE	CLASS
Destroyer Tender	AD-41
Guided Missile Cruiser	CG-47
Guided Missile Cruiser (Nuclear)*	CGN-38*
Destroyer	DD-963
Fast Frigate	FF-1052
Guided Missile Fast Frigate	FFG-7

* Data for the CGN-38 was not available for this study.

Especially important considerations to the study include:

- o All ships, except the Destroyer Tender (AD-41), should be able to occupy a typical berth. The tender will occupy a berth dedicated to it.

- Nesting is to be accommodated. Concept plans should provide full services for one nested ship at each berth while more than one may be provided with reduced services/pressures, etc., through spare connections.

- A typical pier should be 75 to 100 feet wide and 1,200 feet long, providing four 600-foot-long berths.

- For design purposes, a pier should accommodate a maximum of eight ships (four at berth and four nested).

- The upper deck elevation of both the fixed, open-pile platform pier (hereinafter called "pile-supported pier") and the floating pier (at low water conditions) should be Elevation +20 feet MLW or MLLW datum.

- Climatic conditions should be similar to those of the continental United States.

The location of each utility service point on the design ships was established using the "Ship Requirements Data and Pier Design Criteria" document prepared by NCEL. Table A-1, in Appendix A, summarizes these utility service points. It identifies the location and elevation of each service for each design ship for both starboard and port sides. This was used to determine the mean location of each service for the design group of ships (excluding the AD-41 which is to have a dedicated berth). The determination of the mean location of a service point realistically included allowance that the ship could be moored either bow in or bow out, and on either side of the pier. It was found that the location of a service point for each mooring condition for each utility was approximately the same when the distance was measured from a midships location. The method of determining the mean location first found the mean distance from midships to the service points located on the forward port quadrant and the aft starboard quadrant of all of the ships. Then the mean distance of the service points which are located on the forward starboard quadrant and the aft port quadrant was determined. These mean distances of the service points for each utility had a small range of variance from the individual distances for the separate vessels. Therefore, it would only be necessary to put two service points on a pier, each an equal distance from the point on the pier where the midships of the moored ship would be aligned. This would accommodate all ships whether berthed bow in or bow out. The various ship service locations are shown in Table A-1 in Appendix A. The determined mean locations are shown in Table I-2.

Table I-2 is based on distances from a midship location (rather than from the forward perpendicular as is shown in the NCEL criteria document). This accommodates the manner in which ships are moored when nested, which is essentially midships to midships because of the necessary mooring arrangements.

TABLE I-2
MEAN LOCATION OF SERVICES

SERVICE	MEAN LOCATION - BOTH FORE AND AFT OF MIDSHIPS (FEET)
Electrical	25
Steam	62
Potable Water	52
Saltwater	72
Sewage	73
Oily Waste	41
Compressed Air	65
Fuel JP-5	90
Fuel DFM	101

The mean locations of service points aboard the design ships were used to establish the locations of electrical and mechanical services provided on the berthing pier. This requires the ship to moor with its midship location adjacent to the midpoint of the berthing pier. This may be easily accomplished by proper location of the mooring fittings along the berthing pier's deck.

Interference of mooring lines with utility outlet locations on the ship or with hoses should not occur any more frequently when the ship is moored at the midpoint of the berth than when it is moored at any other location along the pier. The locations of the services on the pier best meet the locations on the ship. The required locations for mooring fittings along the pier may be accomplished by defining a recommended mooring plan for each class of ship, and positioning mooring fittings along the pier to properly accommodate all of the design classes.

2.0 GALLERY CONCEPTS

The gallery concepts developed basically comprised a passageway below the main deck to accommodate mechanical and electrical service lines and outlets, and to provide access for vehicles for the maintenance of those utilities. Development of the gallery concepts centered around the accommodation of the utility configuration requirements within the gallery. This section presents a description of the concepts. The electrical and mechanical services are discussed in more detail in their respective sections.

2.1 OVERVIEW APPROACH AND METHODOLOGY

The numerous documents made available by NCEL and other documents from industry (some listed in the Bibliography) provided the base of information for this study. To gain first-hand understanding of the problems and issues, the U. S. Naval Station in San Diego was visited and a meeting was held with their Public Works Office (see Appendix C). Telephone conversations were conducted with numerous engineering, public works and operational personnel at Naval stations in Charleston, South Carolina and Newport, Rhode Island, and with engineering personnel at the Naval Facilities Engineering Command (NAVFAC) Southern Division Office. These lengthy conversations investigated the operational and maintenance aspects of the various mechanical, electrical and lighting systems in use at the facilities while focusing on the related problems encountered and the solutions which had been attempted. (Other contacts made are referenced throughout this report.)

It became apparent that the electrical cable handling and storage procedures were the major utility service problems confronting the stations contacted. The electrical cable handling and storage methods of each Naval station were different. They had tried and abandoned other methods before devising a system which seemed to accomplish the task for them with a minimum of inefficiency for their specific installation.

The approach to the development of the gallery concepts was to find a solution for the electrical cable handling and storage problems. Then a scheme which could effectively accommodate the mechanical lines could be conceived, perhaps along a similar line, and a gallery concept could evolve which would serve the functional requirements of both services.

An innovative means of handling and storing electrical cable was conceived. The requirements for the mechanical services were defined. Then an effective configuration for the pipe runs for the efficient operation and maintenance of the mechanical services was established. The locations of the service connections and their space requirements were developed. Using these developed space requirements, gallery configurations were then conceived to accommodate these requirements. The conceptualization process is documented in Appendix B by sketches and a narrative.

2.2 ELECTRICAL CABLE SOLUTIONS CONSIDERED

Present electrical cable handling methods at different Naval stations appear to range from leaving the cable on deck in a rather haphazard manner, to flaking it on pallets which are removed to covered storage. Some stations have tried to use reels and have abandoned them because they were not powered for deployment and retrieval of the cable, and because they were not permanently mounted. In developing the proposed concepts, the methods presently in use and numerous additional methods were evaluated.

Consideration was given to flaking the cable on both the upper and lower decks, flaking it on pallets and mounting pallets on wheels. Mechanical devices considered included conveyors, monorails, block and tackles, and movable racks. Stacking was considered below deck, on the upper deck in recesses, in trays below deck and in submerged tubes. Structural devices included an articulated truss, collapsible towers (with cable affixed) and "Chiksan" type arrangements. Reel concepts included fixed and wheeled versions on both the upper and lower decks, vertical and horizontal axis, and groupings in tandem, staggered and single rows. The reel capacity considered ranged from a single cable to as many as ten cables stored per drum. These schemes are discussed in Appendix B.

The final recommended concept uses fixed reels, each with the capacity to handle ten cables with lengths of 50 to 200 feet or more. This capacity is easily altered by slight modification of reel dimensions. The reels are to be powered by air motors with appropriate reversing and braking controls. The Electrical Section, Section 3.1, more fully discusses the reel concept.

Should the reel concept not be adopted for a specific berthing pier, the gallery concept is still suitable for use with the other cable handling methods presently employed at Naval stations. Such methods might include:

- Leaving the cables lying on the lower deck.
- Flaking or coiling the cables on the lower deck.
- Flaking or coiling the cables on pallets.
- Flaking or coiling the cables on trailer-type vehicles.

If reels are not provided for any particular installation, headroom, lay-down space and physical access would be available for the handling of cables below decks using any of the methods now applied on single-deck structures.

2.3 MECHANICAL PIPING SOLUTIONS CONSIDERED

A prime consideration in the gallery configuration development was the evaluation of vertical versus horizontal orientation of the mechanical piping runs in the gallery. A vertical arrangement either blocks the access to the electrical reels or to the remainder of the lower deck area as shown on Sketch 1. This is described more fully in Appendix B.

A horizontal arrangement is considered best for installation, maintenance and modification operations, and provides free access to both the electrical reels and to the remaining lower deck area. Although this arrangement requires an increased pier depth within the gallery, the horizontal orientation is superior to a vertical one in that it provides the access to the electrical reels for their removal. The recommended concepts use a horizontal arrangement.

2.4 DESCRIPTION OF GALLERY CONCEPTS

The gallery concepts for both the pile-supported pier and for the floating pier are based upon locating the electrical stations at the center of the berth. This requires proper positioning of the ship while berthing which in turn requires an adequate number of bollards suitably located along the pier's upper deck.

Because the electrical station reel concept requires the positioning of the ship in the center of the pier, it is possible to take advantage of this positioning to establish the mechanical services at optimal locations along the pier. With these locations identified, it is possible to confirm that the space needed for the electrical reels will not interfere with a required mechanical service location. Drawings 1, 6 and 11 depict both the overall pile-supported and floating piers, and show the location and space requirements of all the electrical and mechanical services.

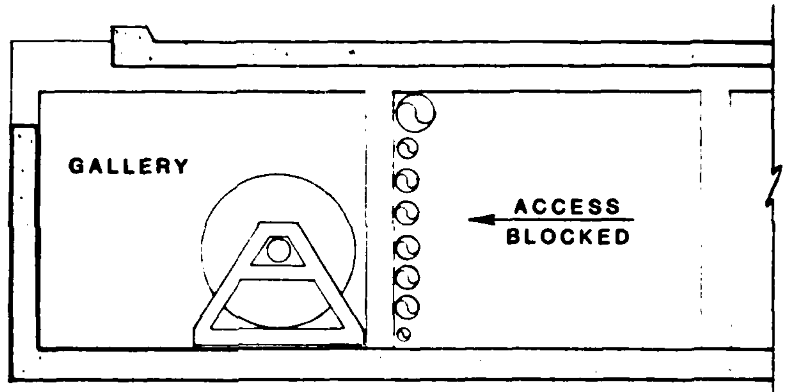
The AD-41's electrical and mechanical service location requirements will be different from the other ships, as may be seen in Table A-1 in Appendix A. The tender has its own electrical cable reels.

2.4.1 Pile-Supported Pier

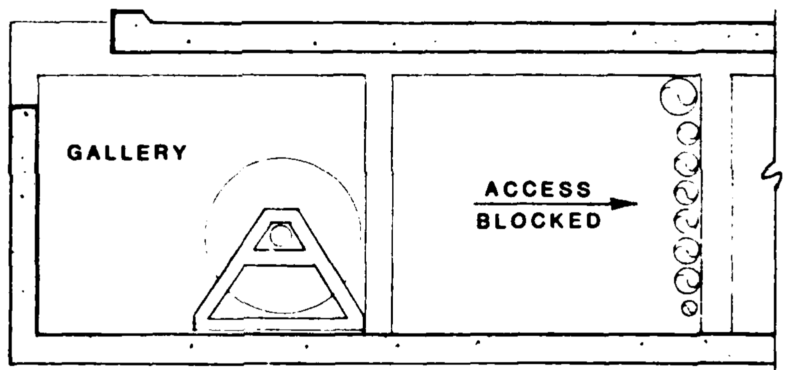
The basic gallery section for the pile-supported pier was governed by the dimensional requirements of the pipe chase (identified in the Mechanical Section, Section 3.2) and by Occupational Health and Safety Administration (OSHA) clearance

SKETCH 1

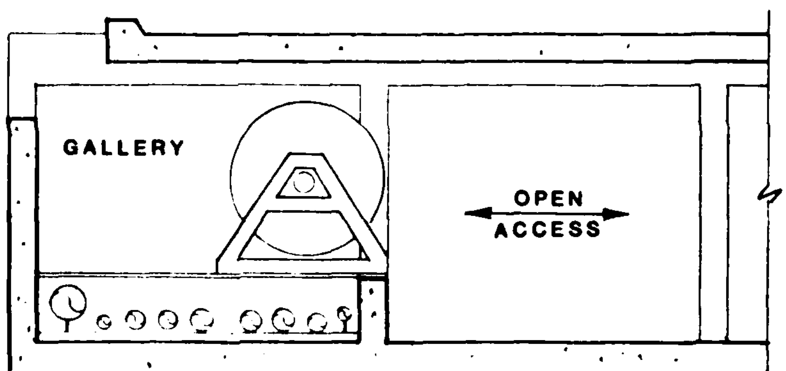
VERTICAL VERSUS HORIZONTAL PIPING ORIENTATION



VERTICAL- GALLERY BLOCKED FROM ACCESS



VERTICAL- PIER INTERIOR BLOCKED FROM ACCESS



HORIZONTAL- FREE ACCESS TO BOTH GALLERY & PIER INTERIOR requirements. The recommended section, shown on Drawing 2, depicts the minimum allowable vertical clearance of 7 feet-6 inches to the bottom of the upper deck and the minimum allowable clearance of 6 feet-8 inches to the bottom of a projecting beam. It shows the pipeway width of 11 feet-6 inches. These dimensions are based on minimum acceptable OSHA clearance requirements (29 CFR 1910.37i) and are not intended to dictate structural dimensions. It may be seen that the recommended 5-1/2 to 6-foot-diameter reel can be adequately accommodated. The roadway section is 11 feet wide and provides 10 feet-2 inches vertically which is adequate for the needed service vehicles. Removal of the reels will be by use of the provided overhead crane rails and chain hoists to simple carts designed to accommodate the reels.

The pipeway is 3 feet-6 inches deep. Together with the OSHA vertical clearance requirements, this establishes a minimum total interior vertical dimension in the gallery of 11 feet. This may result in a rather low elevation for the lower deck if the upper deck elevation is to be maintained at Elevation +20 feet. In certain geographical areas having rather high normal daily tides (see Table A-2 in Appendix A), a restriction of the permissible design or construction options to accommodate the higher tides during the construction of the pile-supported pier concept may result. Either the interior gallery dimensions or the upper deck elevation may require adjustment to meet the restrictions caused by the combination of structural element sizes and higher normal tides.

For example, using the upper and lower deck thicknesses shown in the concepts (i.e., a one-foot-thick slab in both cases, plus a ten-inch dropped beam in the upper deck), the bottom of the lower slab is at Elevation +7.0 feet. If an allowance for a pile cap of two feet is made, the bottom of that cap is then at Elevation +5.0 feet. If falsework requires an additional one and one-half feet of depth, the bottom elevation of it becomes Elevation +3.5 feet, which is quite low for some locations with high daily tides. This might require that pile driving, formwork construction and concrete placement be accomplished during favorable tide periods.

To avoid some of these constraints in such areas, an alternate concept was developed for the pile-supported pier which raises all of the above elevations by one foot. This is shown in the pile-supported pier alternate concept on Drawings 6 through 10. The reduction of the inside dimension by one foot is accomplished by eliminating the lateral piping runs to serve the mechanical stations located along the outboard wall and by establishing the station manifolds directly above the feeding service line in the pipeway (see Drawing 7). This reduces the vertical dimension of the pipeway from 3 feet-6 inches in the base concept shown on Drawing 2, to 2 feet-6 inches in the alternate concept shown on Drawing 7. Aside from this change and the change in the locations of the mechanical manifolds, the recommended and alternate concepts are the same.

All of the elevations discussed above are based on the assumed structural element dimensions used in the example. The actual elevations of the lower members can only be determined during the design of a specific pier project since the final structural element sizes may be affected by such variables as pile bent spacing, deck loading, seismic loading, fender and bollards loading, the structural framing methods selected, and the basic choice of precast versus cast-in-place construction. Variations in the gallery dimensions and elevations of a pile-supported pier may be inevitable.

The elevations of all bottom members may, of course, be altered by raising the elevation of the upper deck above Elevation +20 feet. Drawings 1 through 5 depict the pile-supported pier; Drawings 6 through 10 depict the pile-supported pier alternate.

2.4.2 Floating Pier

The gallery section concept for the floating pier is similar to the concept for the pile-supported pier. The recommended section is shown on Drawing 12.

In developing the pipeway area, it was found that the T. Y. Lin report shows standard 35-ton bollards located on the lower deck. These are reportedly for "only a few AD mooring lines . . . and extra bollards are provided for the general purpose use of mooring various vessels that the pier has not been designed for, such as small craft and barges." These bollards on the lower deck, with their large base requirements, presented a formidable obstacle to providing a good solution for a mechanical pipeway. Since the AD can adequately moor by using the higher level fittings with which it is equipped to secure lines to the main deck, bollards on the lower deck seem unnecessary for the AD. In addition, the small craft and barges which might use the pier may best be served by cleats rather than by the 35-ton bollards shown.

In order to achieve a good solution for the mechanical pipeway, the lower deck fittings are shown as cleats located on a low wall (which could be strutted back to the column at the cleat locations) rather than as 35-ton bollards mounted on the deck as shown in the T. Y. Lin report. This change allows the use of a small base dimension fitting with a reduced capacity which can be mounted at the walkway grating level as shown on Drawing 12. It frees the area previously blocked by the bollards for use as a pipeway.

The pile-supported and floating pier concepts are similar. There is rather generous headroom available in the floating pier concept. Drawings 11 through 15 depict this concept. The potential problems associated with the pile-supported pier concepts due to tidal constraint do not, of course, exist with the floating pier concept.

3.0 GALLERY SERVICES

Previous sections of this report discussed the electrical and mechanical services peripherally as required for an understanding of the information presented. This section more fully discusses the electrical and mechanical installations within the gallery.

3.1 ELECTRICAL UTILITY SERVICES

This section deals with the electrical utility services provided within the gallery, their space and configuration requirements, and the recommended concepts.

3.1.1 Reels

The proposed concept for handling and storing the electrical cable employs fixed reels located in the gallery on the lower deck, completely freeing the upper deck of electrical service components.

In the development of the recommended concept, numerous reel configurations were evaluated and rejected including large diameter, narrow reels, each storing only one or two cables, and two cables stored simultaneously by strapping them together in parallel to ensure level wind on the drum to reduce handling requirements. The narrow reel concept required considerable room in the gallery, the reels were awkwardly shaped for economical fabrication, and considerable mechanism was required. Strapping two cables together provided simplified reeling and unreeling, but prevented the cable from bending in one plane. Attaching small, high strength wire ropes along with two power cables to take the tensile loadings during reeling and unreeling was also considered. However, the tensile strength of the power cable itself was found to be sufficient for the anticipated usage so no additional strength member was required to carry the load.

3.1.1.1 Recommended Reel Concept. The recommended concept uses reels with flange diameters of five feet to six and one-half feet, and drum widths of five to seven feet, with a drum diameter of three and one-half feet. Cables are wound and unwound one at a time, each secured to the end of the previously wound cable with a short lanyard. Between five and ten cables will be stored on one reel in this manner.

The validity of using reels for this purpose was confirmed through discussions held with manufacturers of the specified cable (Type THOF-500, three conductor, 500 mcm stranded copper) as well as with manufacturers of reels. These conversations confirmed the viability of the concept of power-reeling the cable. Although reels suitable for the intended installation are not commercially available, their design and manufacture would use available components and technology. Only the assembly is unique, not its components.

General requirements for the reels were developed as a result of these discussions. A drum diameter of three and one-half feet is recommended, which should result in no significant cable stress in the recommended application. Such reels can hold up to ten cables each, reeled in an end-to-end fashion. The cable will probably be "random" wind rather than "level" wind. The reel flanges will be five or six feet in diameter with a drum width of similar size. Spacers located in approximately two-foot intervals along the drum will aid in the handling of the cable during pay-out and retrieval operations. Each reel will be driven by an air motor through a clutch drive, and will require a braking system as well as free-wheeling and reversing capabilities. Each reel will rotate about a single shaft designed to accommodate static and dynamic forces imposed throughout all modes of the reel operation. The power driving and braking of the reel will be transmitted through the shaft. Bearings may be oversized to allow for reduced maintenance. Roller-type cable guides will assist in retrieving operations.

The reel assemblies will be located in a damp environment in the utility gallery. When specifications for the assemblies are prepared, serious consideration should be given the the materials and coatings to be used for the assemblies. In particular, if dissimilar metals are employed, their relative positions in the galvanic series should be considered. It is possible that when the life cycle economics of the reels are considered, steel may prove to be competitive. If the support framework and the motor, gear drive mechanism, and bearings are all steel, consideration should be given to retaining steel as the material for the reels. If this is done, low alloy, high strength steels or weathering steels should be considered. When special or standard grades of steel are used, a good coating system with good abrasion resistance should be employed.

3.1.1.2 Reel Operation. The employment of a fixed or mobile, powered, articulated boom is envisioned on the main deck. It will utilize one operator and one helper, and will function in such a manner as to replace the existing topside pier crews assigned to manually handle cables. The powered boom will be equipped with cable handling hooks, rollers, slings and guides to handle one cable at a time during both the reeling and unreeling operations. It will have the capability to pass the end of one cable at a time to or from the cable reel. A two-man crew will operate the reel on the lower deck to reel and unreel one cable at a time. The crew on the upper deck will operate the boom and lift each cable from the reel to the ship to be serviced. The two-man crew on the lower deck will control the cable reel during all phases of cable reeling and unreeling. They will also make the connection to the plug-in panel on the lower deck. Entanglement of cables should no longer occur since the cables can easily be re-reeled for storage in the reverse sequence from that used in their deployment.

The time required to hookup or unhook should be shortened due to the absence of tangled cables. Mechanized cable handling operations and ability to lift cable over the ship's side for shipboard crew's handling should also reduce time and manpower requirements. The lack of interference from other activities, due to the dedicated space for this activity on the lower deck, should similarly speed operations. Testing and plug-in or unplug times are not affected.

3.1.1.3 Reel Capacities. The Statement of Work identifies the required length of the electrical cable as 125 feet. The concept recommended may enable the use of shorter lengths and will also permit longer ones. Some field testing may be necessary to establish the most convenient lengths. The reel concept, however, can be tailored to meet a variety of length requirements. The continued use of existing portable power cable and existing Viking plugs is anticipated. It is understood that an in-line adapter accommodating the connection of two Viking plugs is under development and may be used to replace the station practice of making temporary bolted cable connections for each hookup. This would simplify the make up of longer-length cables when necessary. Table I-3 demonstrates calculated reel capacity and reel assembly weight as a function of its size.

Since it is expected that the reels will utilize "random" wind rather than "level" wind, an allowance of 10% for the additional capacity required for "random" wind is needed. In addition, since the terminators are expected to be wound on the reel, an additional 10% allowance

TABLE I-3

REEL CAPACITIES AND WEIGHTS

(BASED ON 3.5-FOOT-DIAMETER DRUMS)*

FLANGE DIAMETER IN FEET	REEL WIDTH IN FEET	REEL CAPACITIES		CABLE AND REEL ASSEMBLY WEIGHTS	
		TOTAL CAPACITY[1]	ESTIMATED DESIGN CAPACITY[2]	CABLE WEIGHT IN TONS[3]	CABLE AND REEL WEIGHT IN TONS[4]
5	5	801	641	2.46	3.3
	5½	881	705	2.70	3.6
	6	961	769	2.95	3.9
	6½	1041	833	3.19	4.3
5½	5	1131	905	3.47	4.6
	5½	1244	995	3.81	5.1
	6	1357	1086	4.16	5.5
	6½	1470	1176	4.50	6.0
6	5	1492	1194	4.57	6.1
	5½	1641	1313	5.03	6.7
	6	1791	1433	5.49	7.3
	6½	1940	1552	5.94	7.9
6½	5	1885	1508	5.78	7.7
	5½	2073	1659	6.35	8.5
	6	2262	1810	6.93	9.2
	6½	2450	1960	7.51	10.0

* Recommended by Cyprus Wire & Cable Company - Manufacturers of ROME Products.

[1] Total theoretical capacity (100%) is based on level wind.

[2] Estimated design capacity is based on total capacity (100%) less 10% to allow for random wind, and less 10% to allow for cable terminators (total theoretical capacity - 20% = estimated design capacity).

[3] Cable weight is based on the estimated design capacity of the reel using 7660 pounds/1000 feet (estimated design capacity of reel x 7660 ÷ 1000 = cable weight in pounds).

[4] Cable and reel weight is based on cable weight plus 33% of the cable weight as an allowance for the weight of the reel assembly (cable weight + 33% of cable weight = cable and reel assembly weight).

is made. This allowance should be field verified, especially if an in-line adapter is utilized, allowing the use of Viking terminators at each end of the cables. The "Estimated Design Capacity" on Table I-3, therefore, provides for a 20% reduction in capacity for these allowances. For example, if ten cables of 125-foot lengths are required, 1,250 feet of storage capacity is needed plus 20% for the allowances, or 1,500 feet total. This could be accommodated on a reel six feet in diameter and five and one-half feet wide (1,641-foot total capacity or 1,313-foot design capacity). It could also be stored on two reels each containing five cables or 750 feet. The reel diameter could then be five feet and the width five feet (801-foot total capacity or 641-foot design capacity). The weights of these reels with cables (maximum capacities) would be 6.1 tons and 3.3 tons respectively.

3.1.1.4 Service Locations. As discussed in the Criteria Section, Section 1.0, the mean locations of each utility service point were developed for the design ships. This located the electrical service points approximately 25 feet to either side of the midship point. To accommodate the concept of fixed reels for the electrical services, the midpoint of the berth was chosen for the reels' location. The space occupied by the reels in this location does not interfere with the location of the mechanical services, as is shown on Drawings 1, 6 and 11.

In accordance with minimum OSHA requirements, the pile-supported pier gallery concept (and the alternate) has a 7 foot-8 inch vertical dimension above the grating. This should allow a reel flange diameter of six feet while still providing sufficient clearance for the reels' removal. The exact flange dimension that will be used may be dependent somewhat upon the design of the bearing assemblies, since vertical movement of the reel to clear the bearing assembly support is necessary. Because the gallery in the floating pier concept (as developed by T. Y. Lin) has more headroom above the grating than the pile-supported pier, larger diameter flanges could be accommodated for the floating pier concept than for either pile-supported pier concept. There are no space limitations dictating the reel width in either concept.

The proposed concepts portray the use of four reels. Two reels could contain 125-foot or longer lengths, and two could contain 50- to 100-foot lengths. Field testing may be needed to establish effective lengths to be used. With modest changes in reel width, large variations in capacity are possible. No difficulty is anticipated in accommodating any reasonable cable length requirement with the recommended reel concepts.

3.1.1.5 Reel Removal and Maintenance. The removal of the reels for cable replacement or maintenance will require certain auxiliary facilities. Two short overhead transverse rails are provided over each reel as shown on Drawings 2, 7 and 12, one over each end of the reel. Two removable chain hoists will be used to lift the reel and move it over to the vehicular accessway. A simple cart or trailer, fashioned to accept the reel, will be properly located in the accessway, and the reel will be lowered onto it. The cart and reel will then be hauled through the corridor and off the pier to a warehousing/maintenance facility.

Reel maintenance is expected to be infrequent and minimal. The primary wear areas are likely to be the power-drive train and braking system. With a prudent selection of materials and protective coatings, corrosion should be controllable.

3.1.1.6 Advantages and Disadvantages of Reels. One of the primary advantages of using permanently-mounted reels on the lower deck is that the upper deck will then be clear of cables, both when the cables are in use and when not in use. The use of powered reels and lifting equipment will simplify the attachment and disengagement of cables to ships and will reduce manpower requirements. Since the cable is stored in an untangled state and in one location on the pier, the use of a top-deck-mounted lifting device can easily expedite handling of the cable during reeling and unreeling. Reeled cables are protected to a considerable degree from damage, especially when stored. The cable is easy to transport when reeled, easy to store and inventory, and offers no safety hazard to personnel.

The procurement of the reel assemblies adds capital cost to a pier, but their use should materially extend cable life, thereby reducing cable replacement costs. Operating costs should be reduced because reels are less labor intensive. Maintenance costs of the reels will partially offset the reduction in operating costs, but not substantially.

3.1.1.7 Use of Gallery Concepts Without Reels. Although the advantages of using reels outweigh their disadvantages, the recommended gallery concepts can be implemented with or without the use of reels. The currently employed manual methods of cable handling are readily adaptable for use in the gallery concepts. Should a two-level pier be considered for construction without the use of reels, however, it is recommended that the appropriate portions of the lower deck be designed for reel use at a later date.

3.1.2 Receptacle Panels

The design and construction of receptacle panels currently in use on piers and aboard ships is well established. A recommended configuration with size and number of such units arranged to match berthed ship panels' needs is presented on Drawings 1, 6 and 11. The exact configuration will be determined for each specific pier when designed.

3.1.3 Pier Telephone Service

After an extensive review of the NCEL-supplied literature on communication, signal and alarm systems, no definitive design parameters emerged. The Statement of Work specifies 15 lines per berth. A cable space allocation has, therefore, been depicted for these lines on Gallery Section Drawings 2, 7 and 12.

3.1.4 AD-41 Dedicated Berth Requirements

A dedicated berth on each pier is proposed for the AD-41 Destroyer Tender. This ship is unique in that it is equipped with the reeled cables necessary to serve combatants alongside it. It is suggested, however, that future specific pier designs also provide cable reel facilities at this dedicated berth in the same locations as other combatant berths, in order to serve berthed ships of other design at the tender berth, when required. Electrical service should also be provided for the tender at a location approximately 210 feet from the center of the berth. This service could be readily provided through a cable tray.

3.1.5 Transformer Vaults

Naval berthing piers usually use a dual-power train incorporating two distribution transformers, rated at about 5,250 kV-A each, plus associated switchgear and accessories, within a single vault. During the development of the gallery concepts, consideration was given to separating the power trains and placing them in two individual, smaller vaults. The purpose was to free the area near the reels for access for reel removal.

The use of two separated vaults was not pursued after a self-contained handling method for reel removal was developed.

There are, however, other aspects of single-train vaults which may warrant future consideration. One is that the space requirements of the two smaller units may be more easily accommodated structurally than a single, larger one. Another is that the fabrication and construction costs of the smaller units could compare favorably with the larger, single vault. Functionally, the two units have an advantage in fire and flooding hazards. Additionally, the possibility of maintaining partial power on the pier is improved. Although additional ventilation and access requirements will result with two units, separating the trains may be worth further evaluation.

3.2 MECHANICAL UTILITY SERVICES

This section deals with the mechanical utility services provided within the gallery, their space and configuration requirements, the service manifold arrangements, and the recommended concepts.

The gallery pipeway establishes certain gallery dimensional requirements. The service station concept establishes a minimum number of service points while maximizing their location convenience. The concepts provide flexible expansion capabilities.

3.2.1 Services Provided

The mechanical utilities provided within the utility gallery were identified in the Statement of Work and include services for hotel, fueling and light maintenance as shown in Table 1-4.

TABLE 1-4
MECHANICAL SERVICES

SERVICE	LINE SIZE
150 psi Dry and Saturated Steam	10-inch-diameter
60 psi Potable Water	8-inch-diameter
150 psi Saltwater	10-inch-diameter
Fuel DFM	8-inch-diameter
Fuel JP-5	8-inch-diameter
Compressed Air	6-inch-diameter
Sanitary Sewage	8-inch-diameter
Ship's Oily Waste	6-inch-diameter
Clear Condensate Return	(Future-space provisions only)

3.2.2 Gallery Configuration Influences

The eight required mechanical services and one future service constitute a space requirement similar in size to a utility tunnel or pipe rack required for a fairly large industrial plant or a medium-sized chemical processing plant. Since these services extend the length of the pier on one axial centerline and are on both sides of the pier, the impact upon gallery layout (cross section) geometry is significant. Ideally, an uninterrupted space, approximately 11 feet-6 inches wide and

3 feet-6 inches deep, will be required for the pipe run along each side of the pier. The 11 foot-6 inch width could be either horizontal or vertical, but if it is vertical, its obstruction to lateral movement on the lower deck must be considered. (A suitable spacing of these large mains is given in Tables A-3 and A-4 in Appendix A.) Spacing of the mains is based on design criteria for industrial and process plants to provide at least the minimum amount of room necessary for maintenance, painting, housekeeping and replacement.

In the pier cross sections shown on Drawings 2, 7 and 12, the 11 foot-6 inch dimension allows for the addition of a future condensate line. Small lines may be added on brackets supported on the 3 foot-6 inch wall, provided care is exercised to avoid blocking replacement and removal access of the larger lines.

All safety requirements have been met including the OSHA headroom clearances required above an industrial grating floor. This area above the horizontal pipeway provides an operating platform for the service stations as well as a storage area for service hose when not in use.

The fuels (DFM and JP-5) handled in the gallery are not considered hazardous. A hazardous material may have to be handled in the future. The present gallery concept is well ventilated naturally which provides safety should a low flash point or highly volatile material have to be handled. This is an important consideration when a two-level pier such as this is designed to accommodate vehicles with internal combustion engines on the lower deck.

3.2.3 Pipeway

All services, including sewage and oily waste collection lines, are considered to be looped, that is the lines on each side of the pier are connected at the outboard end and not dead-ended. Flow to any given station is, therefore, from two directions in the piping system. The lines are also considered to be equipped with sectionalizing or isolation valves. This allows repairs or expansion to be accomplished without a complete system shutdown and provides the hydraulic advantage of a looped system.

Sewage and oily waste are recommended to be pressure or "force" mains rather than gravity collection lines to lift stations. This eliminates the restrictions of horizontal access within the gallery which long gravity lines might impose. Short gravity lines within the pipeway would require greater vertical clearances below the grating, increasing the gallery depth, while overhead gravity lines would again require a deeper gallery to provide OSHA clearances. Overhead lines may interfere with removal of the electrical cable reel.

The location pattern of the mains within the pipeway may be somewhat random, except that the large-diameter steam line should be located as far as possible within the pipeway from the hose station, to allow maximum flexibility of the lateral connections. The location of the sanitary sewage and oily waste lines at the outer edge of the lower deck would provide the pier designer the option of utilizing gravity flow to nearby lift stations if the recommendation to use pressure mains is not adopted. Room is available for other small lines for future services such as oxygen and acetylene or MAPP gas for expanded maintenance requirements, or demineralized water for make up to shipboard steam generation systems.

The pipe mains are supported off the gallery floor by six-inch-deep members spaced at appropriate intervals. This provides a space of six inches between the bottom of the pipe and the gallery floor. Spacing between the pipe mains provides for a minimum of two inches between any flange and adjacent line, which in turn provides approximately four to six inches between the pipes themselves, depending on the pipe diameter.

The laterals are above the mains and perpendicular to them, crossing to the outer area of the lower deck where the hose stations are lined up under the access opening. This is illustrated on Drawings 5 and 16. This configuration allows the flow of the liquids to eminate from the mains upward through the hose station manifolds to the "on board" connection or hose terminus on the ship in an ideal "self draining" configuration, with a minimum of potential spillage at the hose connection point on the pier.

Above the laterals, a structurally self-supported, industrial-type grating provides for both access to the hose stations and storage of hoses and cables. This grating is removable in sections for access to the utility mains and laterals for maintenance or expansion. The stems of the sectionalizing valves should project upward through the grating or extension handles should be provided so they may be operated without removing grating sections. After removal of the grating from above the pipe mains, there is a minimum clearance of four inches to six inches around each pipe giving access for maintenance and repair, painting and housekeeping activities.

3.2.4 Alternate Pipeway Concept

For areas where the vertical dimension of the gallery must be minimized for tidal conditions, an alternative gallery concept was developed for the pile-supported pier. (This is discussed in the Gallery Concepts Section, Section 2.4.) For this concept, the lateral horizontal runs are eliminated, and the hose station manifolds are located directly above the mains. This allows the grating to be placed just above the top of the mains, reducing the vertical clearance and saving one foot of height within the gallery. This is shown on Drawing 10.

3.2.5 Stations

The utility services are provided to the ships from stations located within the gallery on the lower deck. The station concept recommended minimizes the number of stations needed while maximizing their location convenience for the ships. Manifolds are positioned for convenience and safety of operation, and use modern methods for their fabrication.

3.2.5.1 Station Locations. The electrical station reel concept requires the positioning of the ship in the center of the pier. It is possible to take advantage of this positioning to establish the mechanical services at required locations along the pier. (The locations and approximate elevations of service connections aboard the design surface combatants are discussed in the Criteria Section, Section 1.0.) The locations were established in terms of distance fore and aft of the midship points. A listing of suggested mechanical service station locations, each of which is individually located symmetrically shoreward and seaward from the center of each berth, is given in Table I-5. These locations serve all design ships except the Destroyer Tender, AD-41. Locations for the AD-41 are shown in Table A-1 in Appendix A. The proposed location of the services, based upon Table I-5, is shown on Drawings 1, 6 and 11.

TABLE I-5
MECHANICAL SERVICE STATION LOCATIONS

SERVICE	LOCATION FORE AND AFT OF BERTH MIDPOINT (FEET)
Oily Waste	41
Potable Water	52
Steam	62
Compressed Air	65
Saltwater	72
Sewage	73
Fuel JP-5	90
Fuel DFM	101

The location of the service stations on the lower deck isolates personnel operating them from the upper deck activities, thereby eliminating exposure to hazards associated with upper deck activities. Also, the separation of electrical and mechanical services along the lower deck of the pier allows several operators to concurrently make up or disconnect the various services with minimal interference.

3.2.5.2 Flow Requirements. The utility requirements listed in "Ship Requirements Data and Pier Design Criteria" are based upon daily or hourly average rates. It was assumed that the peak flow condition would be three times the average rate and the design of the laterals took this into account. Where flow quantities were unavailable, the laterals were sized on an "equal area" basis, providing a lateral cross sectional area based upon four times the maximum hose cross sectional area. The fuel services have different requirements in that the fuel is taken on board at a specific design rate for a fairly short period of time. Quantity requirements for the fluid flows were checked, where possible, against hose connector sizes. Discrepancies found for DFM were assumed to be attributable to a typographical error. Since DFM requires a connecting hose of approximately the same size as the main, the lateral is given the same size as the main. Similarly, four JP-5 hose nozzles represent approximately the same flow area as the main. That lateral is given the same size as the main. The hotel quantity requirement was used for saltwater. When required flow quantities were used as a basis of design, general industrial and process plant sizing criteria were utilized.

For any given service, the "Ship Requirements Data and Pier Design Criteria" document indicates considerable variation in flow requirements and in hose connection types and sizes. Therefore, the manifold connection sizes provided in the design of the hose stations are the largest required for any design ship considered. When necessary, adapters may be used for the shipboard connections. To standardize hose sizes, these adapters should be used at the shipboard terminus of the hose. An exception to this is compressed air, for which manifolds have been provided with several 3/4-inch-diameter adapters to match design of the ships' quick disconnect fittings. The manifold inlets are sized as an extension of their incoming laterals.

As indicated in the Criteria Section, Section 1.0, service for one berthed ship and one nested ship at each berth is provided plus spare connections. Since several of the design ships have duplicate connections at the same location, and data was not available for all ships, four hose connections were provided at most manifolds. The DFM manifold is the exception where only one connection is provided because of the limiting main size.

3.2.5.3 Station Descriptions. In general, for the materials of construction, no significant changes from present industry standards are anticipated or recommended for the near future. However, the use of welded-steel manifolds is recommended for hose stations, but does represent a deviation from current practice for some services. Welded-steel construction is commonly used for DFM, JP-5, steam and sometimes compressed air services. However, the use of flanged, cast-iron fittings for water-related services such as saltwater, sanitary sewage, oily waste, fire water and potable water is almost universal due to their inherent long life, municipal codes, American Water Works Association (AWWA) guidelines and other regulations for water supply services. The use of welded-steel manifolds is recommended for these services based upon the excellent record from the petroleum industry's use of them. When the manifolds are hot-dip galvanized both inside and outside after fabrication, no problems should arise if adequate and strategically located small couplings are added to the manifolds to prevent air pocketing during the dipping process.

The recommended concepts are shown on Drawings 4 and 5, 9 and 10, and 14 and 15. The concepts locate the mechanical stations relatively close together. They are designed, therefore, as compactly as possible without sacrificing operability. The length of the stations is reduced by the use of flanged manifolds of welded fabrication using lateral-sized pipe and fittings. Hose connection nozzles are spaced as close together on the manifolds (considering the sizes and types of couplers involved) as is consistent with adequate clearance for make up of the hoses at the connection. In most cases, the use of weld-o-lets, or other commercial, welded-type nozzle outlet reinforcing pads (instead of welded tees) is recommended to save space. The sanitary sewage station is an exception to this because 6-inch-diameter hose nozzles could not be placed much closer together than the 14-inch dimension of a standard 8-inch-diameter welded tee fitting. A substantial savings in space is derived by the use of welded manifolds instead of conventional cast-iron, flanged fittings. The elbow entry to the manifold also saves space over a welded tee and two weld caps and represents a hydraulic advantage over a tee entry, since approximately four to five times more line friction loss is encountered through a tee as through a long-radius welded elbow.

Potable water stations are recommended which incorporate reduced pressure principle backflow preventers, with spring-loaded swing check and bleed mechanisms, which do not require horizontal installation. The bleeds should be left open for observation. (The use of reduced pressure principle backflow preventers is addressed in AWWA Section C-506.)

All clean services, such as compressed air, saltwater, potable water and especially steam, incorporate the use of depressurizing bleed connections at each hose nozzle outside of the valve to prevent accidental uncoupling of a pressurized hose that is still connected at the shipboard end. Compressed air stations include several reducing adapters with 3/4-inch-diameter quick disconnect couplers attached with chains to prevent loss. Saltwater connections for both fire water and shipboard usage are on the lower deck. The connection of a fire hose to combat a nearby fire is probably more safely made below deck than above, however, a parallel set of fire hose stations located on the upper deck level could also be provided if desired. Sewage stations are equipped with a 2-1/2-inch-diameter nozzle, to which a saltwater hose could be attached for the application of saltwater main pressure, should this become necessary. All stations are provided with coupling caps or flanges for manifold nozzle closures, and are attached to the manifolds by chains.

The hose connection nozzles are "trained" or pointed in the general direction of the "on board" connection based upon the locations and differences in elevation anticipated between the manifolds and the majority of the ship connections. The manifolds will be supported by tee or L stanchions anchored to the lower deck. This is shown on Drawings 4, 9 and 14.

The self-draining aspect of the manifolds, provided by the location of the manifolds above the mains, precludes the need for traps at the steam or compressed air stations. This results in a space saving since "boots" or drip legs are not required. Trapping for these services is, therefore, required only at the main. Although present operations usually allow steam condensate to be dumped, a condensate return main may be required in the future. Compressed air traps may be discharged into the oily waste main. Provision for thermal expansion and contraction of the mains is anticipated to be made within the space provided for each main within the pipeway by expansion joints, a practice currently in widespread usage. However, the location of the steam line in the pipeway will allow the use of shallow loops, if so desired. Trapping would then be required on either side of the vapor pocket formed by the loop.

3.2.5.4 Station Operation. A wide range of hose weights is encountered for the various services. These range from approximately 25 pounds for a 50-foot length of 3/4-inch-diameter compressed air hose, to approximately 1,150 pounds for a 50-foot length of 8-inch DFM hose with flanged ends. Heavy-duty steam hose weighs approximately 250 pounds per 50-foot length when fitted with the threaded brass drive couplers.

While potable water, saltwater, fire, oily waste and compressed air hoses are within the lifting capacity of one man, steam, sewage, JP-5 and DFM will require two or more men for handling. Consequently, the use of external lifting devices, either on the pier or on board the ship being serviced, is advisable for the heavier lines. The station design, therefore, is based upon the concept that only one man would be needed on the lower deck to make up or break the hose-to-manifold connection and to operate the valve.

The station manifolds are located along the outer edge of the lower deck. Since the upper deck is set back from the lower deck, the hose lengths may be lowered to or raised from the station while vertically supported either from an external device or by seamen aboard the ship to be serviced. The manifolds are located above the gallery grating at a height of approximately three and one-half or four feet which is convenient for making the connection. The hose connection can, therefore, be made by one person standing erect within the gallery and facing the ship. Eye contact can be maintained by the man on the pier's lower deck with the crewman on the ship's deck, or with the equipment operator or the man directing the lifting of the hose. The hose connection may then be made without the need for the person who is making the connection to simultaneously support a portion of a heavy hose.

Access to utility stations is provided by ladders from the upper deck at each station location and by vehicular access from the shoreward end of the pier. Vehicular crossover can be provided at the seaward end of the pier and at other areas as required. Access to the lower deck should probably be restricted to Public Works Department personnel and others having a need for such access.

3.2.6 Hose Storage

Small hoses used in services which do not require cleaning after each usage may be stored on the lower deck gallery grating either flaked, in coils or on reels. They may alternately be strung out lengthwise atop the grating to facilitate drying when necessary. This arrangement could be adopted for compressed air, steam, saltwater and fire water hoses. Potable water, DFM, JP-5, oily waste and sanitary sewage require some sort of decontamination or cleaning procedure after each usage. It is envisioned that the storing of hoses on the deck gallery grating would be done selectively such that the areas adjacent to the hose stations would remain clear at all times so as not to impede personnel access.

Compressed air hose, in sizes ranging from 3/4 inch to 1-1/2 inches, may be readily stored on manually-powered reels or simply coiled and left in coils on the grating near the hose area. Depending on the size of any such reels, they could be mounted overhead at the station, attached to the underside of the upper deck, or placed beneath the manifold. The stiffer steam hose would require a larger reel diameter and probably would be more easily left in coils on top of the grating. A 50-foot length of steam hose with connectors weighs 200 to 250 pounds and requires supplemental lifting for easy coiling and uncoiling. Saltwater and fire water hoses are generally collapsible which does not readily lend them to coiling.

Hoses requiring sanitization after each usage are usually transported to an off-pier site for treatment. They are not returned until shortly before reusage. Regardless of the configuration in which they may be returned (coiled, flaked, loose or on pallets), adequate space is available on the grated area above the wide pipeway serving the stations for their storage. Due to the weight involved, 50-foot lengths of DFM, JP-5 and sewage hose will require lifting equipment on, or available to, the hose return vehicle, or extra manpower must be available for their unloading. The development of portable units for in-place cleaning of these hoses below deck could warrant further consideration.

3.2.7 Gallery Drainage

Removal of rain water, washdown water and waste liquids that spill or accumulate in the gallery is to be accomplished by sloping the lower deck under the pipeway to a series of sumps, where permanently-installed sump pumps pick up the oily or contaminated water and discharge it into the oily waste main.

3.2.8 Loading Arms

In accordance with the Statement of Work, hose stations have been provided for each service previously listed. However, the Navy should consider the use of fixed, counterbalanced loading arms in DFM and JP-5 services. While this is in opposition to the concept of a completely clear upper deck for the pier, significant advantages in labor savings and sanitation improvement may be realized by their use. Commercially-available devices are readily available both in cable and sheave design, as identified in the NAVFAC Design Manual DM-25.1, as well as pantagraph design types. They are widely used in industrial and marine terminal applications. Specialized design is readily available, and power operation is commonplace with large arms. When not in use, they are secured and locked in a vertical configuration occupying little deck space.

Eight arms per pier would serve both DFM and JP-5 services, replacing the two hose stations at each of the four berths. Very little savings in hose costs would be realized, however. The operating envelope of the arm is fixed, so a short length of hose would be required to reach the connections of the different ships served at the inboard berth. Additional hose would be required for loading the nested ships and a loading arm provides no special benefit for them. The first hose connection would be made up on board the receiving ship by shipboard personnel. Pier personnel would unlock the vertically-stored arm, operate it to reach the crewmen on board, and open the valve when the shipboard connections were complete. Drip pans to prevent spillage on board when the hoses are being disconnected would be the responsibility of the ship.

Since the loading arm is self-draining from the apex, the pier-operated vent valve allows the outboard leg to drain to the shipboard fuel tank and the inboard leg and vertical section to drain back to the pier gallery main if it is not pressurized. Often the loading arm is founded on a shallow pedestal in the middle of a concrete basin with a sump adjacent to the pedestal. Adjoining the loading arm base atop the pedestal is a small, inexpensive gear pump. Fuel oil trapped within the inboard leg and vertical section may, therefore, be pumped around the closed loading arm block valve and into the pressurized main without spillage.

When lubricating the swivel joints or dissembling them for maintenance or replacement, small amounts of oil or grease may be spilled. This is caught in the basin (which may also fill with rain water), diluted with water and drained to the sump, from where the oily mixture may be pumped into the oily waste main.

While loading arms are ordinarily associated with high-volume users such as marine bulk loading terminals and piers, commercial tanker operation, fuel docks, etc., the labor saved and spillage prevented is a function of the number of times used, not the total volume pumped through them.

Consideration of the use of loading arms in the sewage service opens the possibility of developing a treating unit for decontamination in place. After lengthy flushing with saltwater, a disinfectant could be injected into the capped outboard coupler through a small secondary opening. The disinfectant could flow through the arm and into the sewage main.

In any event, the development of a standardized flushing and chemical treatment system for sewage hose, which could be located on the lower deck, could be given consideration.

4.0 FULL SCALE MOCK-UP

A simple shop fabrication design for a full scale mock-up of a section of the pile-supported pier concept was developed. This is shown on Drawings 17 and 18.

The mock-up is designed to be constructed economically of standard-size lumber and plywood on a concrete foundation. The design will accept personnel loadings of 100 psf. This will permit access by personnel to all portions of the mock-up in order to provide a true spatial experience of all aspects of the gallery configuration. All elements of the gallery design are modeled and are painted to provide for easy component identification.

The full scale mock-up provides an inexpensive means of evaluating the adequacy of the human engineering aspects of the design. The positioning of the various components of the gallery may be evaluated through actual simulation of the operational procedures.

Validation of the design concepts and verification of the positioning of all of the gallery elements, their relationship to each other and the work-space areas available may, therefore, be accomplished before incorporation into a pier construction project.

5.0 RESULTS AND CONCLUSIONS

Concepts were developed for open and closed-type utility galleries suitable to pile-supported piers and floating piers. Alternate approaches to the concepts conceived during their development are included in Appendix B.

Definitive designs were prepared for the recommended pile-supported pier concept plus an alternate which reduces the vertical dimension by one foot when such a reduction is beneficial, easing construction when it is subjected to limiting tidal constraints. Definitive drawings were also prepared for a floating pier.

The concepts recommended for both the pile-supported pier and the floating pier are similar. Both concepts used an "open gallery" concept, that is, both have openings for ship-to-shore utility line egress which are essentially continuous along the entire length of the structure. This continuous access is a distinct advantage which may allow utility stations to be developed for new ship classes in the future without regard to pier opening constraints. Should structural needs require that these openings be limited to the locations of utility stations, the same concepts can still be used. The concepts would then be referred to as "closed gallery" versions.

The recommended concepts utilize air-powered, fixed reels on the lower deck to both store and/or pay-out the electrical cables. This unique feature requires positioning of ships alongside the pier to match the electrical station, which can be easily accomplished by properly locating the mooring fittings along the pier. Since the position of the ship is then predetermined, mechanical stations can be established in optimal locations to serve the group of design ships with both a minimum length of hose and a minimum number of pier deck manifold locations. Locatioas of all service points on the design ships were compiled and suggested locations for services along the pier were developed.

Mechanical piping in the galleries is located in a horizontally-oriented pipeway below a grating walkway, providing both easy maintenance and flexible expandability. Mechanical stations, located above the walkway, provide an easy access to services.

Electrical cable reels and receptacles are mounted above the walkway and have good accessibility. The reels are removable by contained crane rails below deck, and transported on simple carts through the gallery vehicular accessway for maintenance or replacement. Should conventional, manual handling of the cable be desired in lieu of reels for a specific pier application, the gallery concepts can adequately accommodate such operations.

Schematic drawings, showing cable and hose connections in place from shore to ship, were developed.

A simple shop fabrication design for a full scale mock-up of a section of the pile-supported pier concept was developed. The mock-up may be used to validate the design concepts.

II. BERTHING PIER LIGHTING

(SUBTASK NO. 2)

This subtask involves the investigation and development of requirements for suitable lighting intensity levels for berthing pier decks, and a preliminary definitive design for a lighting system to provide those levels with a minimum of components that interfere with other pier deck functions.

1.0 EXISTING FACILITIES

Brown & Root Development, Inc. (BARDI) personnel visited the berthing piers at the San Diego Naval Station on October 13 and 14, 1982 (see Appendix C).

The only permanent pier lighting on any of the piers consisted of shaded curb lights at about 50-foot intervals. The off-pier lighting level was low, originating from shipboard lights located from 20 feet to 40 feet above the main pier deck, which resulted in random light patterns. Light levels were metered on Piers Number 2 and Number 3 using a WESTON PHOTRONIC footcandle meter (Model G19, Number 1236) corrected for visual and cosine response. The weather was ideal, clear sky with a temperature of approximately 70°F. The light pattern from the pier curb fixtures formed a fan-shaped configuration with light intensities immediately adjacent to the fixtures ranging from 10 to 20 footcandles. This rapidly diminished to an unreadable level five feet to ten feet away. The shipboard lighting fixtures provided a pier level lighting of less than five footcandles at the two or three brightest spots along the pier. The berthed ships' gangways were lighted with self-contained rows of small-wattage lamps. The pier was generally free of surface obstructions; however, where obstructions did exist, their outline was distinguishable so as not to be a trip hazard to pedestrian traffic. All of the berthing piers observed were found to have illumination levels essentially the same as those measured on Piers Number 2 and Number 3.

Base personnel stated that when topside tasks require a higher illumination level than is normal on a pier, temporary lighting fixtures supplied by the Naval Base are rigged to provide lighting adequate for the task.

From the observations and comments made at the Naval Base, certain problems and needs appear. The San Diego Base has a built-in requirement that temporary lighting be used because of the minimal amount of permanently-installed lighting. A "clean deck" which the curb light installations provide is, therefore, not possible to maintain during periods of nighttime activity. These problems tend to exacerbate existing conditions associated with station personnel regarding crew sizes, working hours, planning, scheduling and safety. The working situations and conditions observed are extremely labor intensive.

Numerous telephone conversations were conducted with personnel at various Naval installations on the East Coast, including those at Charleston, South Carolina and Newport, Rhode Island. Some of the comments received expressed facts and opinions including:

- Sodium lamps are preferred over mercury vapor lamps, although both are used. One station was originally equipped with mercury vapor lamps and, as piers are updated, the lamp replacements are sodium.

- Curb lamps are useless.

- A light level of 20 footcandles is not attainable on a pier having a "clean" main deck.

- A light level of five footcandles may be achievable but not with uniform intensity.

- Any topside obstruction will be destroyed by forklifts, trucks and the like.

- Illumination of the pier from tower-mounted fixtures at each end of the pier was used.

- One berthing pier, which is 1,000 feet long and 200 feet wide, has a covered topside shed over part of the pier.

- Safety is emphasized and practiced at the stations.

- While the light levels have not been read and recorded, some are estimated to be between five and ten foot-candles.

- Luminaires are mounted on the sides of a pier shed and also on poles. Poles do not cause undue problems on that pier.

- Lights are sometimes required during normal work hours because of the geographic latitude.

- Light levels of five to ten footcandles are sometimes justified for security reasons.

The existing facilities at some stations were considered to be submarginal. Although no light level readings were known to have been taken and recorded, even the marginal improvement in light intensities, resulting in lamp changes from mercury vapor to high-pressure sodium, was viewed as an improvement. It would be interesting to determine if perhaps poor lighting and limited visibility are in large part responsible for the practice of physically destroying topside obstructions by moving vehicles. Some piers have buildings, light poles and an estimated five to ten footcandles of light on the main deck. These topside obstructions are not considered problems on these installations, perhaps because they can be seen.

2.0 ILLUMINATION LEVEL CRITERIA

The primary criteria source considered was the Naval Facilities Engineering Command (NAVFAC) Design Manual DM-4.4, "Electrical Engineering - Electrical Utilization Systems," December 1979, Sections 7 and 37. The manual addresses area lighting and recognizes the "Illuminating Engineering Society of North America" (IES) as the reference authority when no specific criteria is otherwise provided. The IES Lighting Handbook classifies numerous pier tasks and assigns recommended light criteria conditions for each task, fully recognizing that the implementation of that criteria may not be met on as large an area as a pier. The Naval Civil Engineering Laboratory (NCEL) recognizes and lists additional pier tasks which are included in this report.

Pier lighting is needed for security, safety and specialized high-tempo tasks which can be grouped into three categories:

- o Main deck activity involving:
  - Moving vehicles such as personnel auto arrival, parking and departing.
  - Driving, maneuvering and positioning vehicles that handle cargo.
  - Operating boomed vehicles that hoist and lower cargo.
- o Cargo placing, loading, handling and securing, plus the securing and removing of stevedore gear to cranes using shackles, hooks, bridles and slings in the handling of cargo.

o Ship berthing support, hotel/housekeeping services, intermediate-level maintenance and refit, and the ever increasing operational training.

The first two categories, which are generally manual tasks involving medium to large physical components, have low light level requirements. The third category (particularly operational training), often dealing with smaller physical components which require color matching and the reading of written material, will require a significantly higher lighting level.

The 1981 Application Volume of the IES Lighting Handbook states in Section 2, "Lighting System Design Considerations," Page 2-3, "Illuminance Selection and Application," that since 1958, the Society has been publishing single-value illuminance recommendations based on a method established at that time. Since 1979, the Society's committees have recommended new interior lighting standards using a new range approach with a weighting-factor guidance system reflecting lighting-performance trends found in research. Since these new standards have not as yet been applied to exteriors and certain other applications, the Society's original recommendations still apply for outdoor illumination. From Figure 2.2 of the IES Lighting Handbook - 1981 Application Volume, the values in Table II-1 are given:

TABLE II-1
IES RECOMMENDED ILLUMINANCE LEVELS
(AS EXTRACTED)

AREA/ACTIVITY	FOOTCANDLES
Piers	
Freight	20
Passenger	20
Active Shipping Area Surrounds. . . .	5
Shipyards	
General	5
Ways.	10
Fabrication Areas	30

Section 2, "Lighting System Design Considerations" (Pages 2-44 and 2-45), "Lighting for Safety" of the IES Lighting Handbook - 1981 Application Volume states: ". . . Safe conditions are essential to any inhabited space and the effect of light on safety must be considered. The environment should be designed to help compensate for the limitations of human capability. Any factor that aids visual effectiveness increases the probability that a person will detect the potential cause of an accident and act to correct it."

Table II-2, extracted from the IES Lighting Handbook - 1981 Application Volume, lists "illuminance levels regarded as absolute minimums for safety alone."

TABLE II-2
IES ILLUMINANCE LEVELS FOR SAFETY
(AS EXTRACTED)

Hazards Requiring Visual Detection	Slight		High	
Normal Activity Level	Low	High	Low	High
Illuminance Levels Footcandles	0.5	1.0	2.0	5.0

3.0 INDUSTRIAL EXPERIENCE

The petrochemical/petroleum and related industries have 24-hour-per-day operations which use both permanently-mounted and portable/temporary lights. Use of portable/temporary lights occurs infrequently (e.g., once a year) and is prompted by a need for above-normal operating luminescence levels. Experience reveals some useful facts:

- o The use of IES-recommended luminescence levels yields more light than is needed to safely operate indoor/outdoor manufacturing plants.
- o Installation of a permanent lighting system should be adequate for all anticipated frequently recurring tasks with sparing use of supplemental lighting, e.g., for infrequent or unforeseen maintenance turn-arounds.
- o The labor and equipment required to transport, rig and remove temporary lights is equivalent in cost to the initial installation of a permanent system.
- o The storage and handling of individual lights and their mounts results in a high breakage rate.

- o Avoid designing permanent lighting systems with a known need for auxiliary portable/temporary lights but, when the need does arise, use luminaires mounted on wheels.

- o Portable/temporary lighting will not provide the quantity and quality of illumination sought.

Recommended light levels (published in the 1981 Application Volume of the IES Lighting Handbook) have remained unchanged since 1962. The manufacturers and marketers of lighting system components contribute heavily to the content of IES and although their input is useful, their composite recommendations may not best serve specific needs.

The petrochemical/petroleum and related industries tend to downgrade the recommended light values published by IES. The common approach to outdoor lighting design is to minimize the total number of light sources, to use long-life lamps and to maximize the use of high-wattage luminaires. The high-wattage luminaires can be successfully applied only from mounting heights of over 20 feet. Outdoor facilities inherently have many obstructions which interfere with achieving uniform light levels. However, this does not appear to create seeing difficulty or personnel hazards so long as smaller wattage, pendant-mounted luminaires are placed near areas of concentrated activity. The smaller wattage units are generally equipped with reflectors to focus light at the task area and minimize glare since such luminaires are typically mounted below the 20-foot level.

The design of lighting systems for industrial plants has changed significantly in the past three decades. The quantity and quality of light sources have improved. Light control has improved, giving the designer an additional tool. Light pattern control and the use of fewer but larger luminaires with higher efficiency have allowed the lowering of total light output without sacrificing light quality and utility. These innovations have permitted a long-term reduction of applied light levels from the recommended levels without jeopardizing personnel health and safety.

4.0 LIGHTING INDUSTRY FORWARD LOOK

Since major manufacturers have optimized fixture designs utilizing computer technology, future light fixture efficiency increases will be small. There is an efficiency improvement as lamp wattages increase. Fixture designs are now available with sharp beam control. Present high-performance lamps operate near the critical temperature of the lamp materials. Lamp efficiencies are not expected to improve significantly pending development of new lamp materials. Information from the lighting fixture industry indicates that future lighting improvements will be essentially in the efficiency of fixtures intended for use in multiple, high-level applications. Thus, lighting designs which are based on the use of the luminaires of current manufacturers are not likely to become obsolete in the next 10 to 20 years.

5.0 LIGHTING SYSTEMS

The existing methods of lighting Navy piers have been investigated, industrial methods compared and future trends discussed. The evaluation of available systems is discussed in this section.

5.1 ALTERNATE SYSTEMS CONSIDERED

The use of portable "plug-in" type lights mounted aboard ship but dock fed is a hybrid arrangement with multiple disadvantages. This type of lighting system satisfies the "clear deck" restraint by passing the problem to the ship deck and fails to eliminate associated high maintenance, high breakage and high labor costs. Mobile cranes are required to mount and secure large wattage, plug-in luminaires. This task can only be completed after the ship is berthed rather than before berthing, which impacts the scheduling of station personnel.

The use of portable "plug-in" type lights on the upper deck also results in several disadvantages. The application of any supplemental lighting technique incorporates all the economic disadvantages experienced using the shipboard-mounting scheme. Other negative aspects are that the "clear deck" objective is violated thus causing clutter and trip hazards. The quality of the light obtained will be poor and will produce glare problems.

The use of stanchion-mounted fixtures, with the stanchions being removable from the main deck when not in use, results in a paradox. Permanently-mounted stanchions on the main deck offer no interference to main deck usage when there is no activity. When there is no main deck activity, the removable stanchions are secured. When there is main deck activity, the removable stanchions are in use part time. There are no advantages for such an arrangement. The disadvantages include high cost, high maintenance and high breakage.

The use of recessed curb lighting, as observed at the San Diego Naval Station, makes no light contribution to a well-designed berthing pier lighting system. The pier deck is clear but the illumination is inadequate and light patterns are unacceptable.

The use of pole-mounted fixtures in clusters provides noticeable advantages in power efficiencies, economics, safety, flexibility, versatility and light control. A properly designed system using long-life lamps and high-quality fixtures will be virtually maintenance free, will not require supplemental light, and the areas where work tasks are performed will be uniformly lighted. The disadvantages are that some main deck clutter exists and the lighting system must be designed.

The use of permanently-mounted fixtures on a dedicated towable trailer/cart offers some advantages and disadvantages over the previous alternatives. The quality of light over other portable light usage does not improve but the time and labor involvement is reduced. There is an overall reduction in deck clutter. First costs are higher.

It should be noted that a permanent deck lighting system should be designed with the idea that no supplemental light will be used, thus avoiding the need even of trailer-mounted portable lights.

5.2 DESIGN VARIABLES

The designer of a pier lighting system has three primary variables at his disposal. They are fixture selection, lamp selection and fixture mounting heights. Using these variables, in conjunction with a computer lighting design program, provides a new and powerful ability to achieve suitable lighting for the typical pier.

Although mercury vapor lamps are extensively used now, they are rapidly being replaced by improved lamps. Mercury vapor lamps may be preferred for trailer-mounted fixtures because of the lower glare effect. The use of incandescent lamps is not recommended because of low efficiency and short life. High-pressure sodium lamps are a superior light source with high efficiency and long burning hours, providing acceptable color and maintenance of good lumen output. Metal halide lamps have similar application as high-pressure sodium lamps except they are slightly less efficient.

6.0 RECOMMENDATIONS

This section presents BARDI's recommendations for illumination intensities and type of lighting system.

6.1 ILLUMINATION LEVELS

For safety, the minimum recommended maintained main deck illumination level should be 0.5 footcandles.

For high tempo, 24 hour/day-type tasks as listed, the recommended main topside pier illumination level should be 5.0 footcandles.

6.2 LIGHTING SYSTEM

The use of pole-mounted fixtures in clusters is recommended.

The illumination levels recommended may be obtained with six standards for a 1,200-foot-long pier. These standards would each mount eight to twelve high-pressure sodium fixtures at a fifty-foot height.

Section 7.0, Computer-Developed Pier Lighting System, presents verification that the recommended illumination levels can be attained by such a system.

When a lighting system is designed for a specific pier installation, that design should provide deck illumination at least equivalent to the computer-designed system depicted on Drawing 19, and with equivalent components shown.

The luminaires should be circuited to allow for selective light control appropriate for safety, ship berthing and high-tempo requirements.

7.0 COMPUTER-DEVELOPED PIER LIGHTING SYSTEM

A computer program has been applied to develop and verify a lighting design for a typical berthing pier. Several cases were analyzed and the results are presented on Drawing 19 which shows footcandle light levels which generally meet the design requirements taken from the pier lighting recommendations. Improvements in this design are possible since it has not been optimized. The light levels shown can be readily achieved using fixtures, lamps and poles with the programmed characteristics indicated.

The objectives of the lighting system are generally: place an average of 5.0 footcandles of light on a large area of the pier with smoothly varying intensity levels; place lower footcandle levels at the outboard end of the pier; use energy economically; and provide a lighting system with adequate lighting for multiple tasks (thereby avoiding the future need for temporary lights). The lighting system lends itself to be controlled using programmable controller logic for selective switching to further energy economizing. The design is hazard-free except for the six pole obstructions.

7.1 COMPUTER INPUT

The computer program is designed to store statistical data which characterizes the physical components used in a lighting design. Manufacturers' data was entered into the program without establishing the merit of one over another. Thus, the stored data was not optimized. The number, type and wattage of the lamps and the aiming points were altered during numerous computer runs.

The principal input data used for the final computer run consisted of:

- o Six poles - 50-foot long at specific positions along either side of the pier.
- o Fifty-one - 400-watt lamps in fixtures to give varying output photometrics.
- o Four - 100-watt lamps in fixtures to give varying output photometrics.
- o Separate aim points for each luminaire.
- o A dock dimension of 1,200 feet by 80 feet.
- o Instructions to read footcandle levels at 300 points on the deck and 50 points through a vertical section extending from the deck to 40 feet above the deck at the 920-foot point along the pier.

7.2 COMPUTER RESULTS

Drawing 19 presents the computer-drawn light intensity curves from the numeric printout. This sample berthing pier lighting design demonstrates that design objectives are reasonably met. Good lighting has been achieved using 20,800 watts. Further analysis of this design could be conducted. It is possible and practical to observe light levels and patterns resulting from luminaire programming, i.e., selectively turning luminaires on or off according to light requirements of various tasks.

The primary result of this computer-designed lighting system is the demonstration that a 1,200-foot by 80-foot pier can be lighted safely and adequately with a minimum of topside interference. Additionally, the use of computer software in lighting system design has a broad application as an analytical tool. It can quickly and accurately evaluate system economics, light intensities, light control and other design options at minimum engineering costs.

8.0 RESULTS AND CONCLUSIONS

Familiarization with present-day lighting systems on Naval piers was obtained through a visit to the San Diego Naval Station and through telephone conversations with other Naval stations. There is an obvious lack of standardization among the types of lighting systems and significant variation in the lighting levels employed by the various stations.

Naval manuals and industrial codes failed to provide consistent guidance about the necessary lighting levels for the various tasks to be performed on the piers. Industry experience for similar task requirements was employed to obtain the recommended minimum level of 0.5 footcandles for overall lighting levels and 5.0 footcandles for high-tempo tasks.

An evaluation of the numerous types of lighting systems that could be employed was made and the conclusion reached (based upon extensive industrial experience) that standards of moderate height supporting multiple-fixture arrays could be located on a 1,200-foot-long pier with minimal interference with other activities.

Information obtained from the lighting fixture industry indicates that future lighting improvements will be essentially in the efficiency of fixtures intended for use in multiple, high-elevation applications.

A computerized design demonstrated that suitable, uniform lighting levels can be provided. The system depicted on Drawing 19 uses six 50-foot standards with each supporting eight to twelve high-pressure sodium fixtures. An isophotal plot was computer-generated to display the results (see Drawing 19). Portable units are neither required nor recommended when the proposed system is adopted.

A computer-generated vertical section of the lighting levels above the deck is also given on Drawing 19. This shows that a loading operation using cranes will have uniform lighting levels at various elevations above the deck level.

Since the standards utilize multiple fixtures, final designs can provide programmable switching to obtain the minimum recommended overall levels of 0.5 footcandles and the maximum recommended 5.0 footcandles for high-tempo areas with selective reduction of lighting levels for berthing operations.

Although considerable additional work would be needed to achieve a final, optimized design for a specific pier installation, the computer plot shown clearly demonstrates that the light intensity provided is both reasonably uniform and complies with the recommended illumination levels. The high-pressure sodium fixture provides an acceptable quality light of high efficiency. Final lighting design for a specific pier can be computer-generated to provide an infinite variety of solutions for individual applications.

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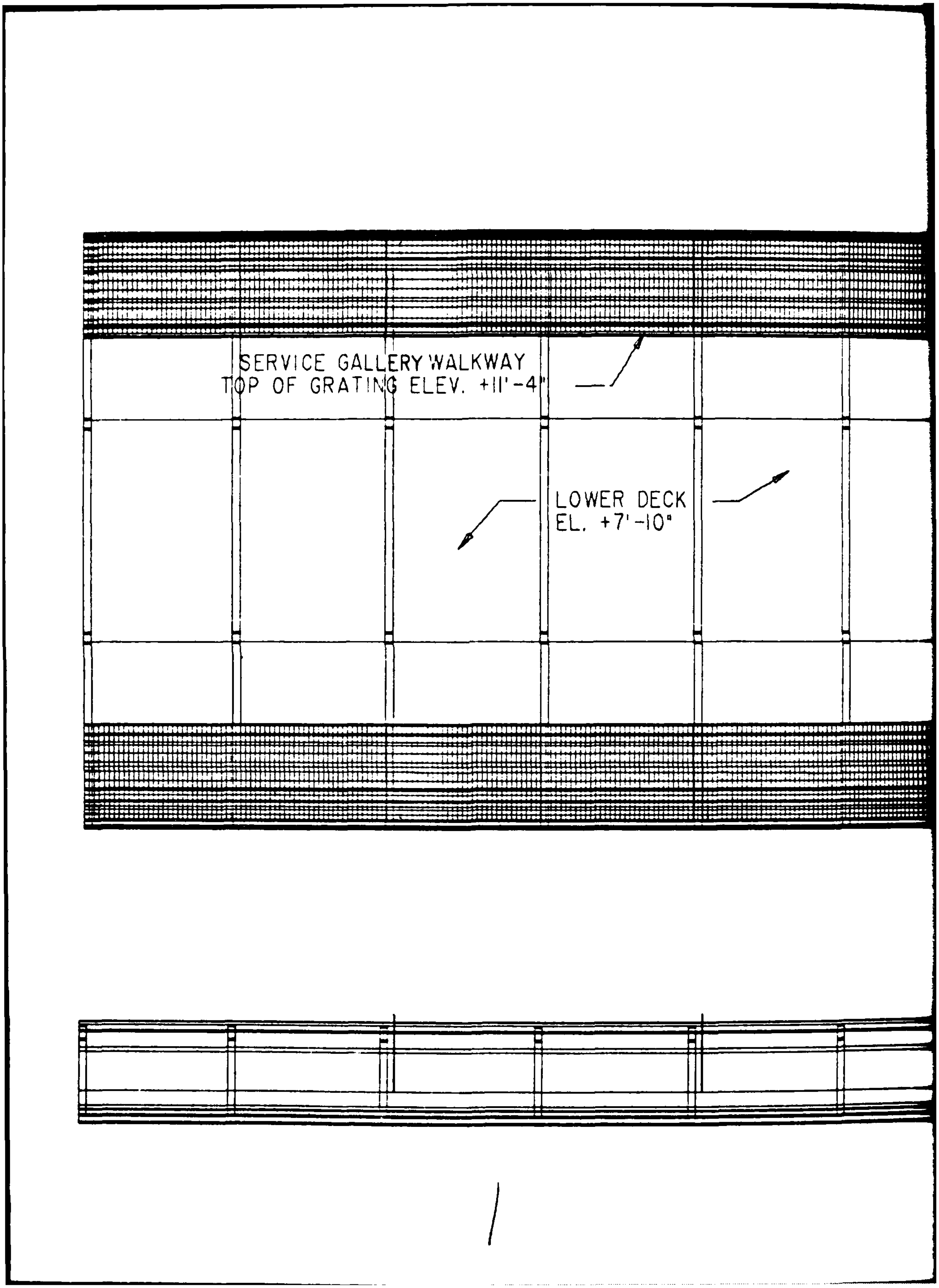
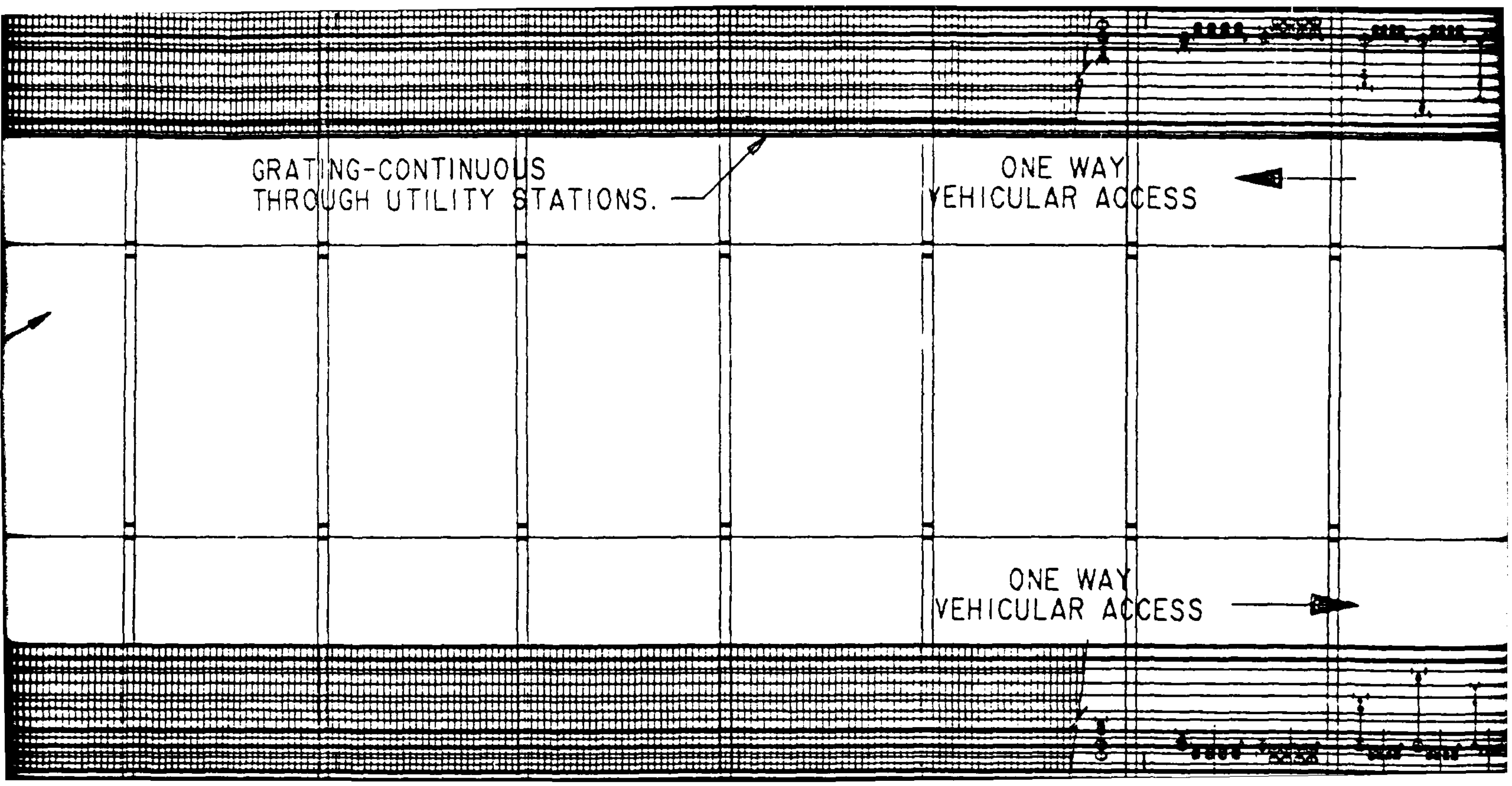
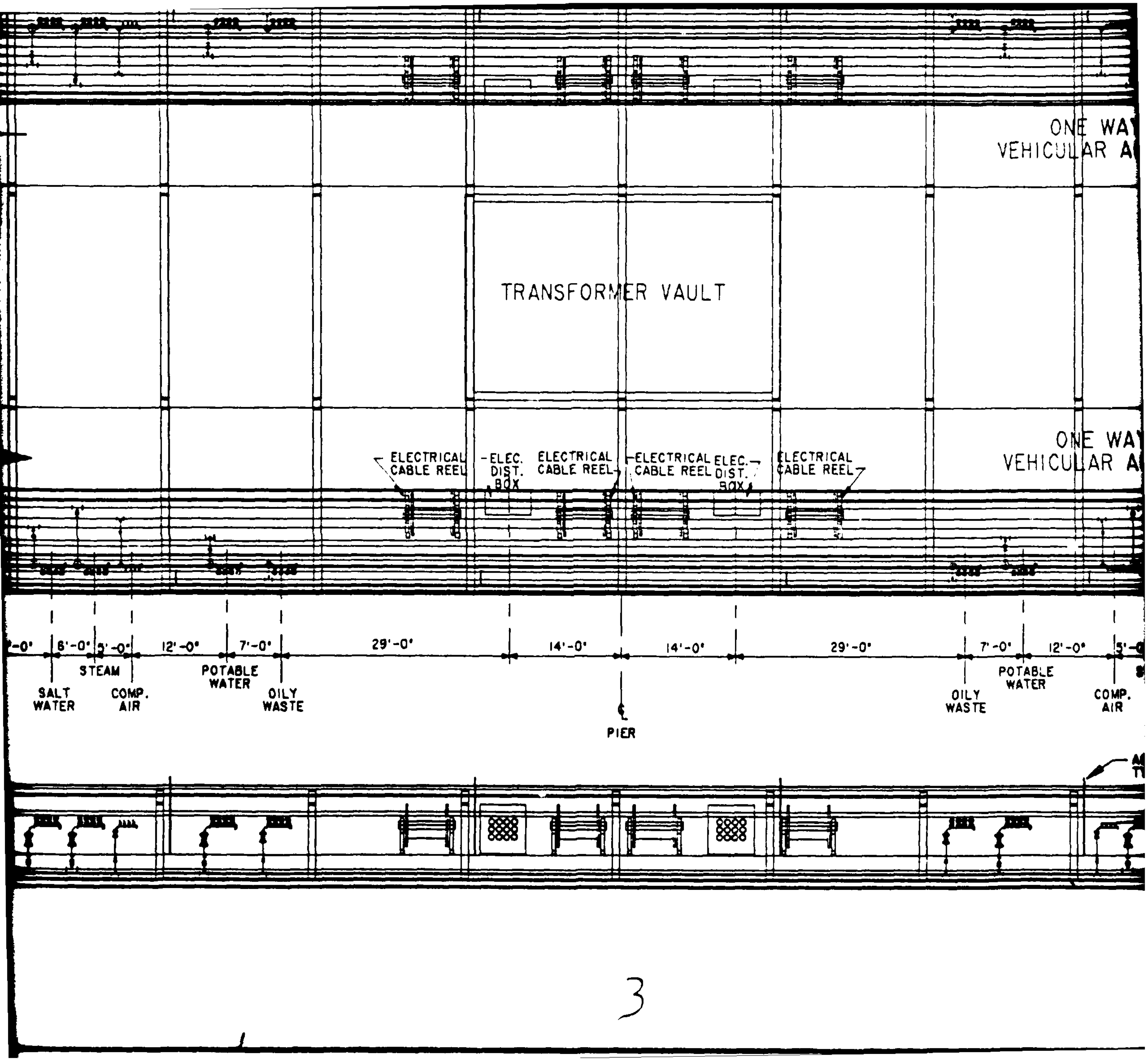
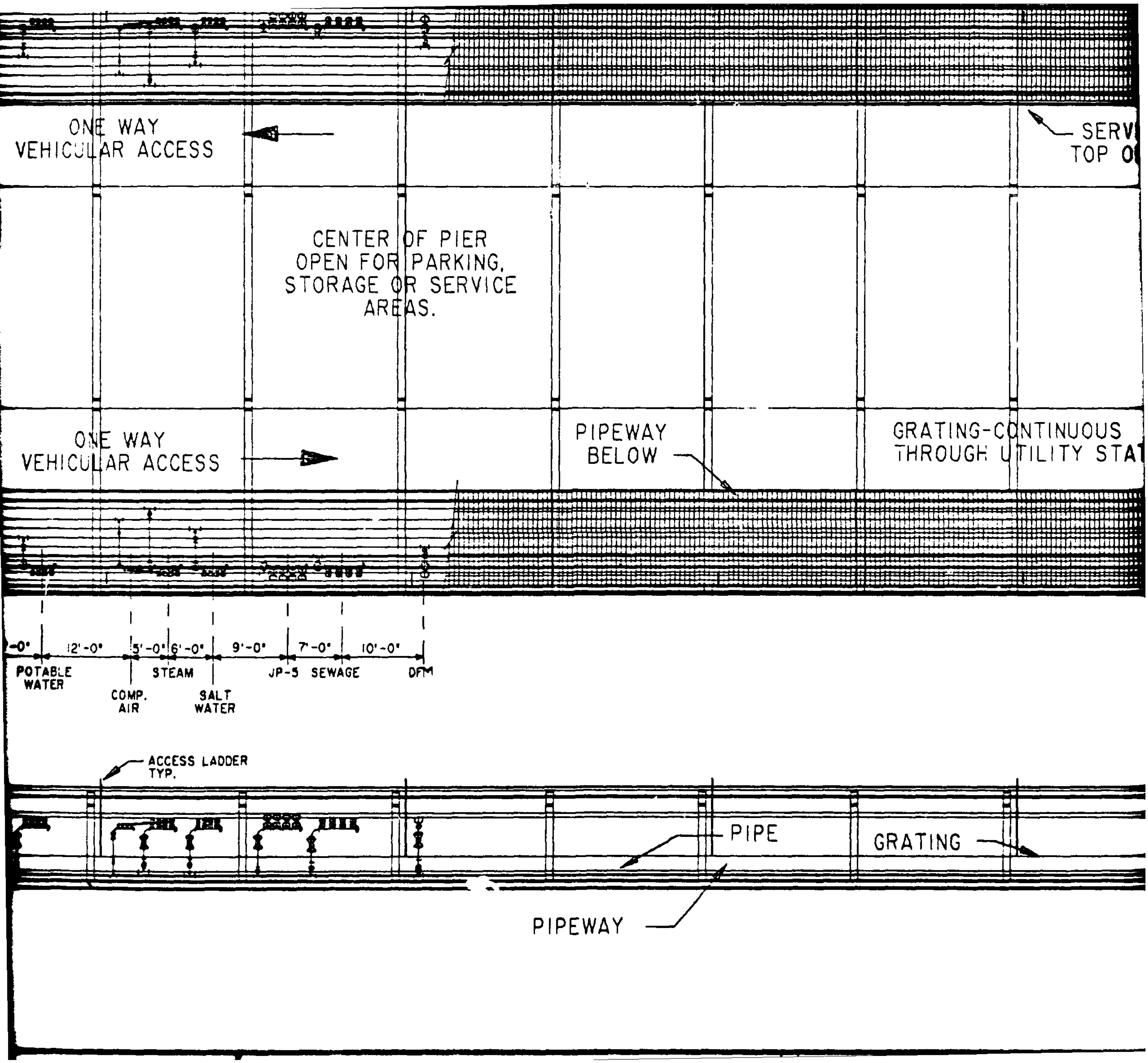
DRAWINGS

CATEGORY	DRAWING NUMBERS
PILE-SUPPORTED PIER	1 THROUGH 5
PILE-SUPPORTED PIER ALTERNATE	6 THROUGH 10
FLOATING PIER	11 THROUGH 15
CABLE AND HOSE CONNECTIONS	16
MODEL FABRICATION (MOCK-UP)	17 AND 18
PIER LIGHTING	19

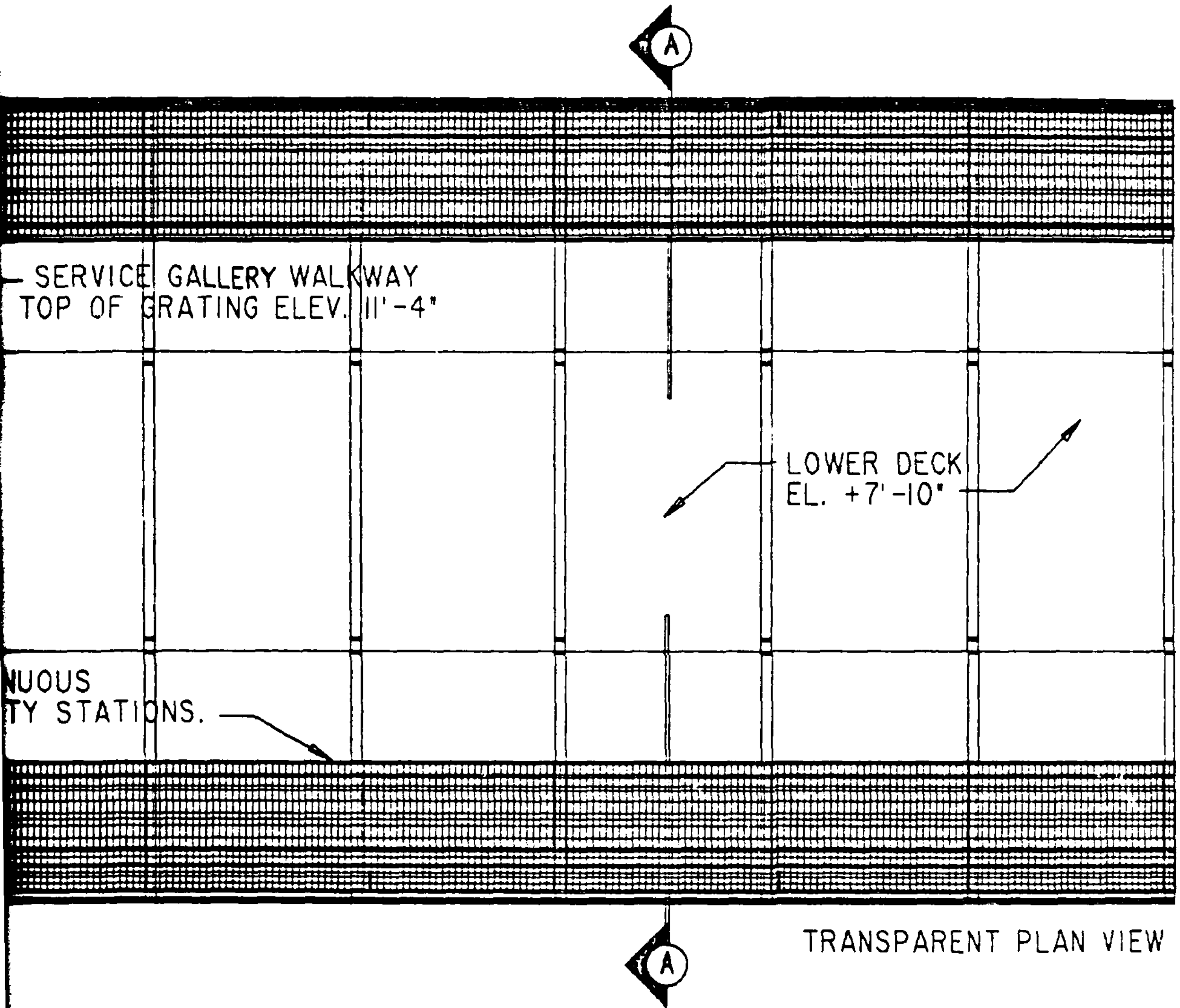

SERVICE GALLERY WALKWAY
TOP OF GRATING ELEV. +11'-4"
LOWER DECK
EL. +7'-10"


GRATING-CONTINUOUS
THROUGH UTILITY STATIONS.
ONE WAY
VEHICULAR ACCESS
ONE WAY
VEHICULAR ACCESS

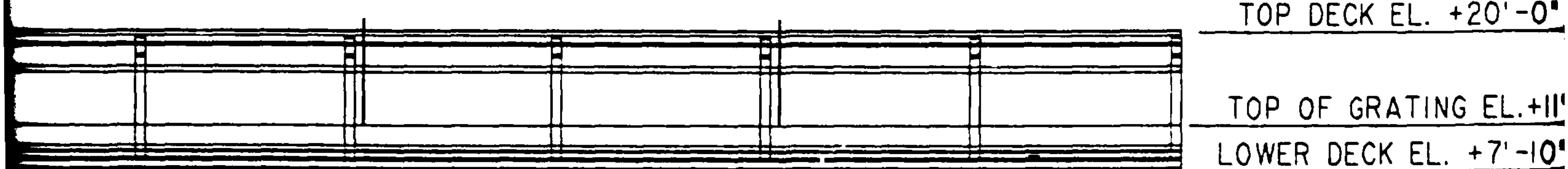

ONE WAY
VEHICULAR A
TRANSFORMER VAULT
ONE WAY
VEHICULAR A
ELECTRICAL CABLE REEL
ELEC. DIST. BOX
ELECTRICAL CABLE REEL
ELECTRICAL CABLE REEL
ELEC. DIST. BOX
ELECTRICAL CABLE REEL
8'-0"
5'-0"
12'-0"
7'-0"
29'-0"
14'-0"
14'-0"
29'-0"
7'-0"
12'-0"
STEAM
POTABLE WATER
SALT WATER
COMP. AIR
OILY WASTE
PIER
OILY WASTE
POTABLE WATER
COMP. AIR
3



ONE WAY
VEHICULAR ACCESS
SERV
TOP O
CENTER OF PIER
OPEN FOR PARKING,
STORAGE OR SERVICE
AREAS.
ONE WAY
VEHICULAR ACCESS
PIPEWAY
BELOW
GRATING-CONTINUOUS
THROUGH UTILITY STA
12'-0"
5'-0"
6'-0"
9'-0"
7'-0"
10'-0"
POTABLE
WATER
STEAM
JP-5
SEWAGE
DFM
COMP.
AIR
SALT
WATER
ACCESS LADDER
TYP.
PIPE
GRATING
PIPEWAY

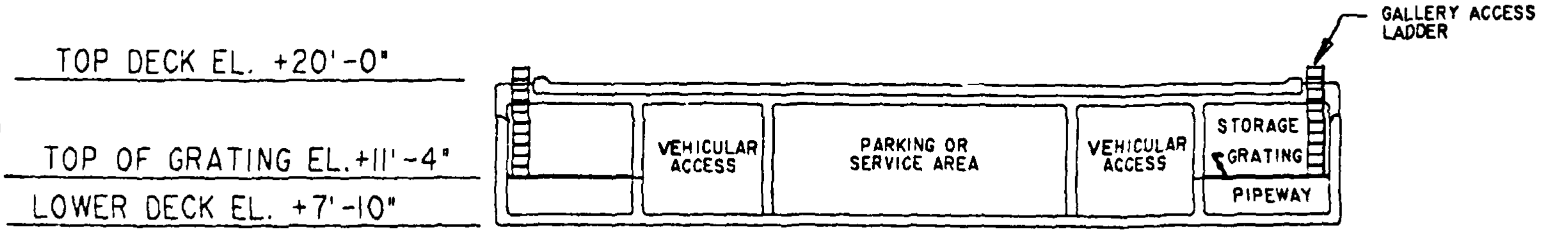


TRANSPARENT PLAN VIEW

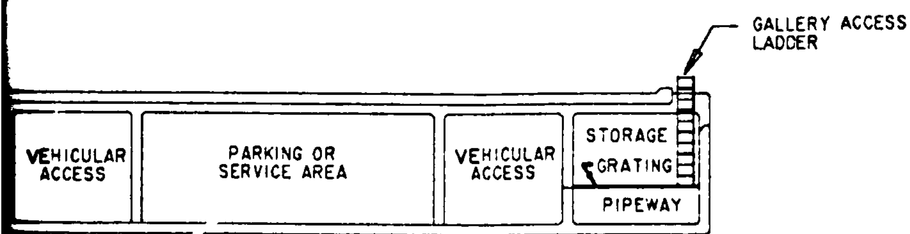


TRANSPARENT ELEVATION VIEW

W



END SECTION VIEW A-A



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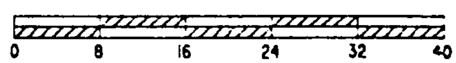


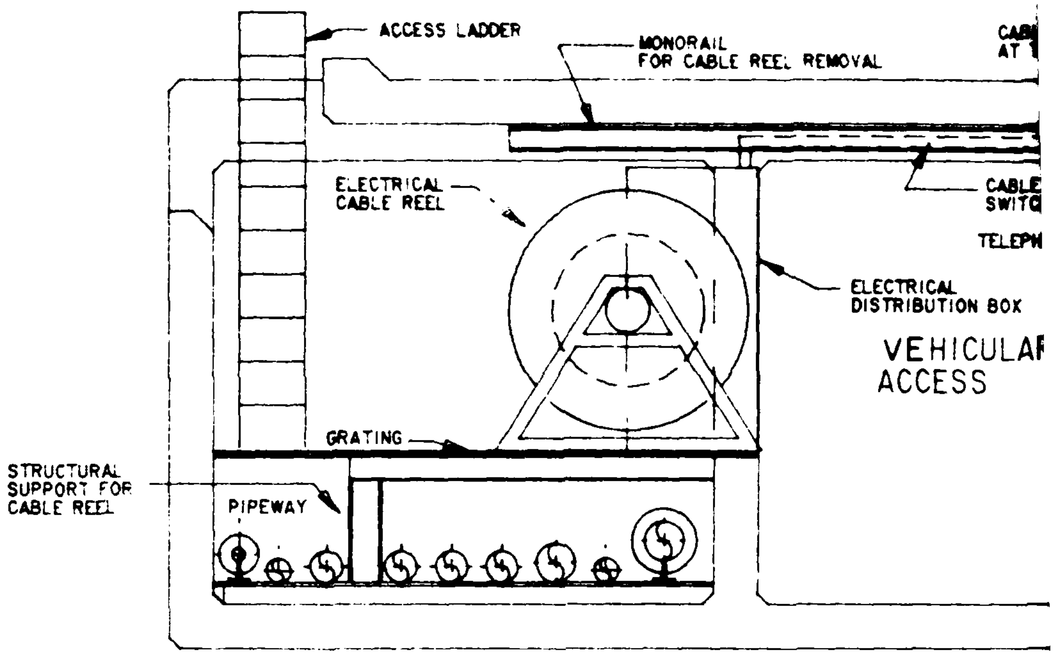
CONTRACT N 62474-82-C-8303

CONCEPTUAL AND DEFINITIVE DESIGNS
FOR BERTHING PIER UTILITY GALLERY

PILE SUPPORTED PIER
PLAN, ELEVATION & SECTION

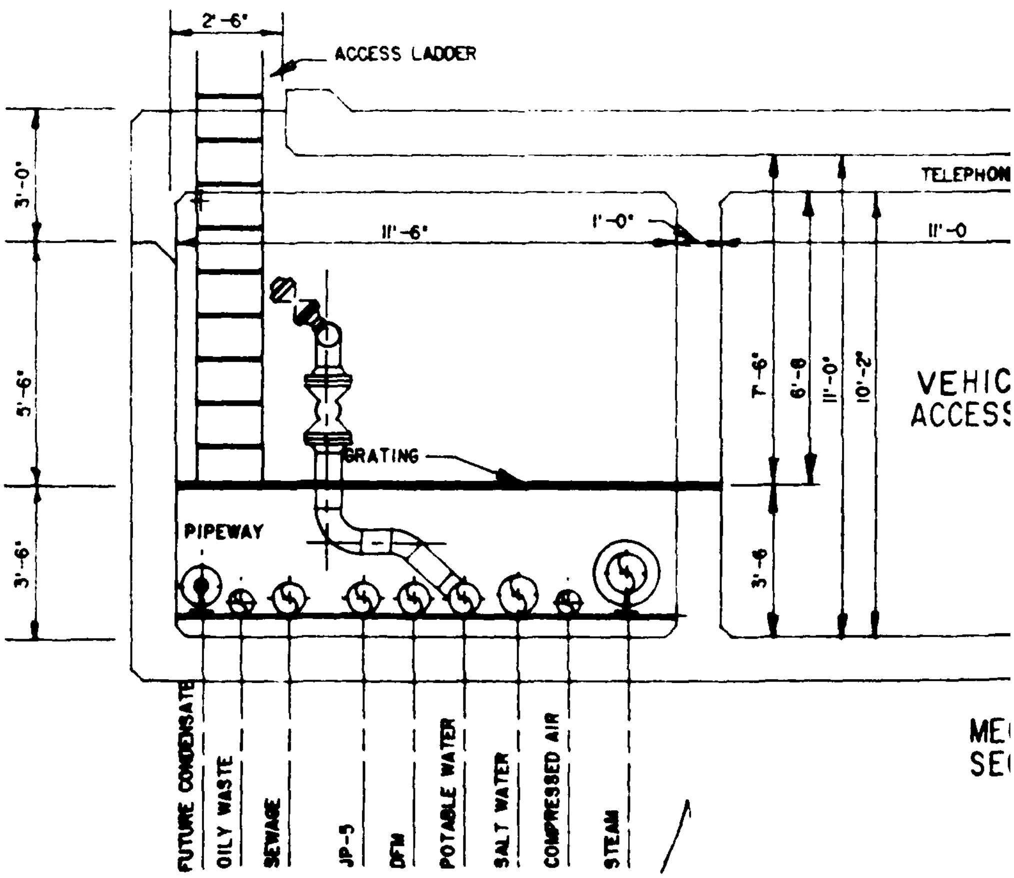
DRAWING NO. 1

BROWN & ROOT DEVELOPMENT, INC.

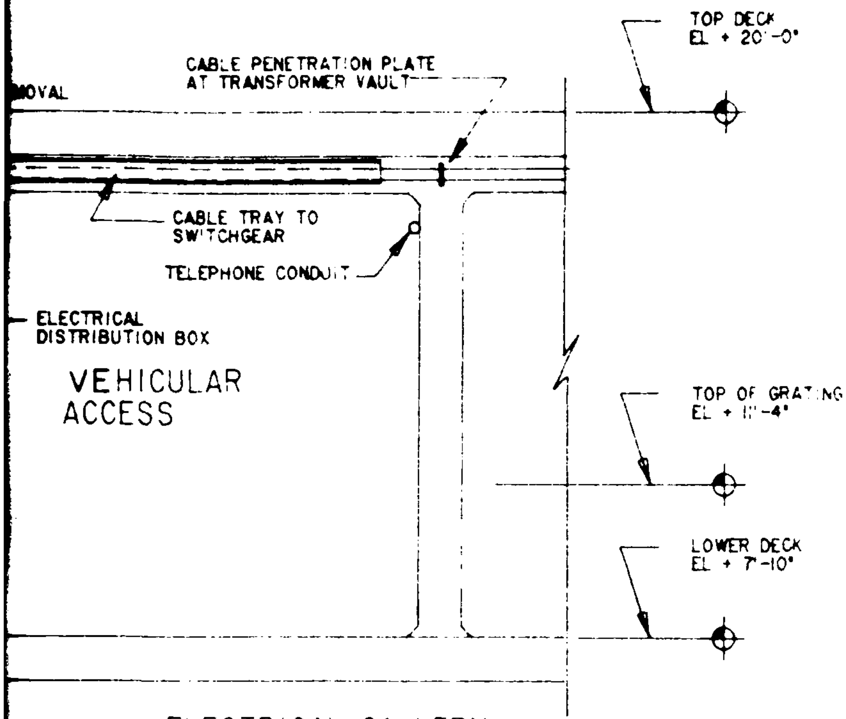


ELEC
SECT

NOTE:

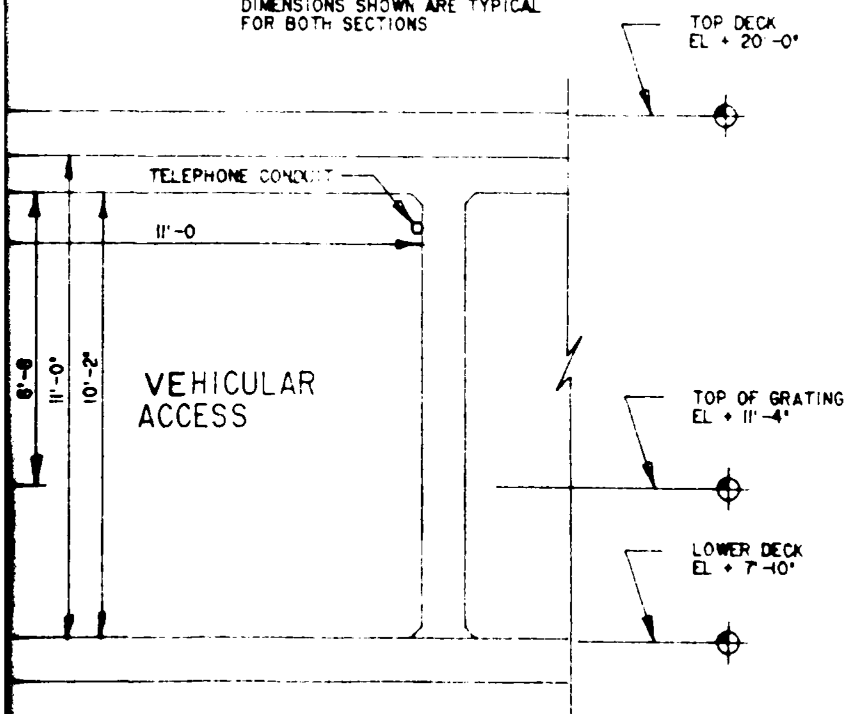


ME
SE



ELECTRICAL GALLERY SECTION

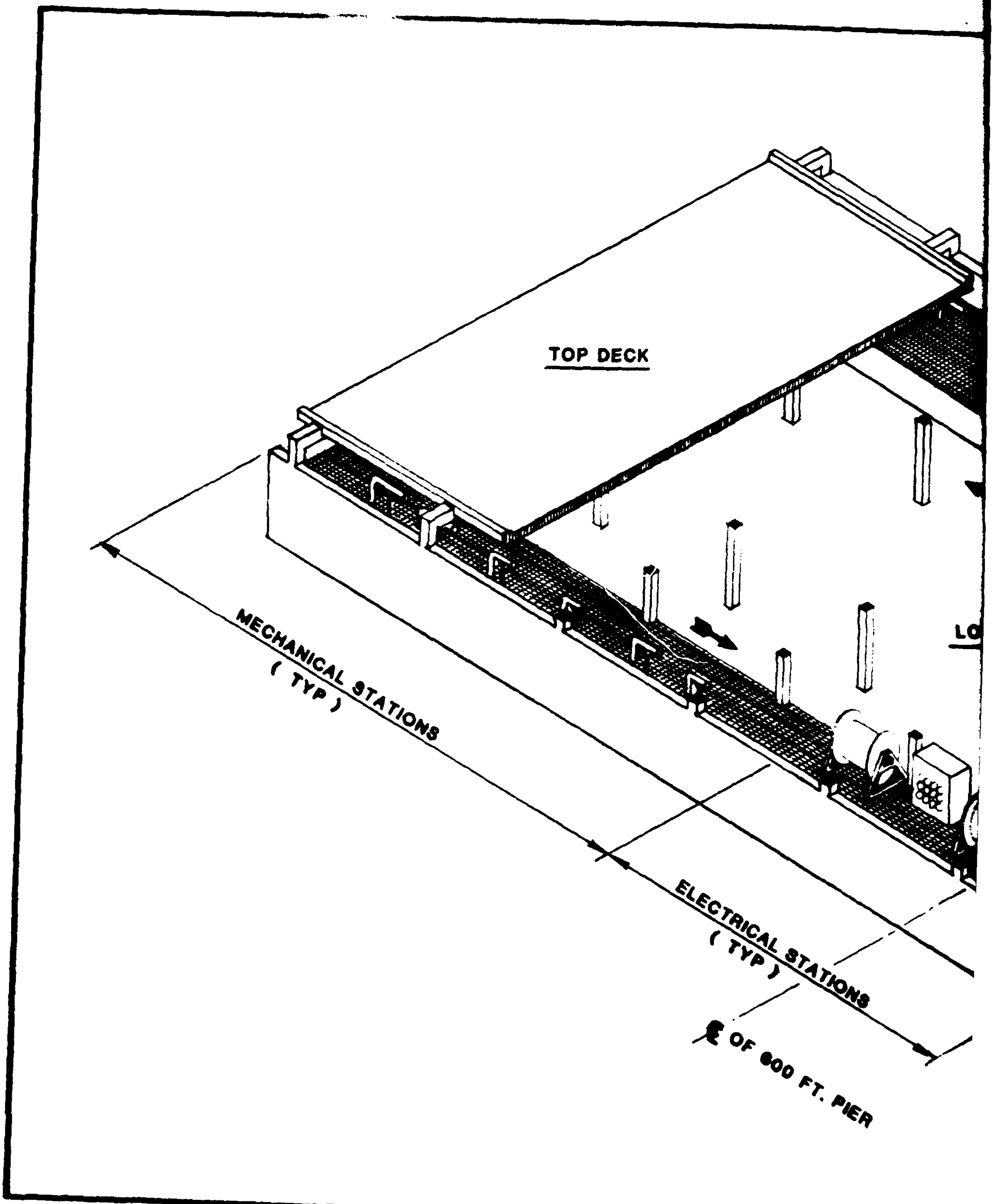
NOTE:
DIMENSIONS SHOWN ARE TYPICAL FOR BOTH SECTIONS

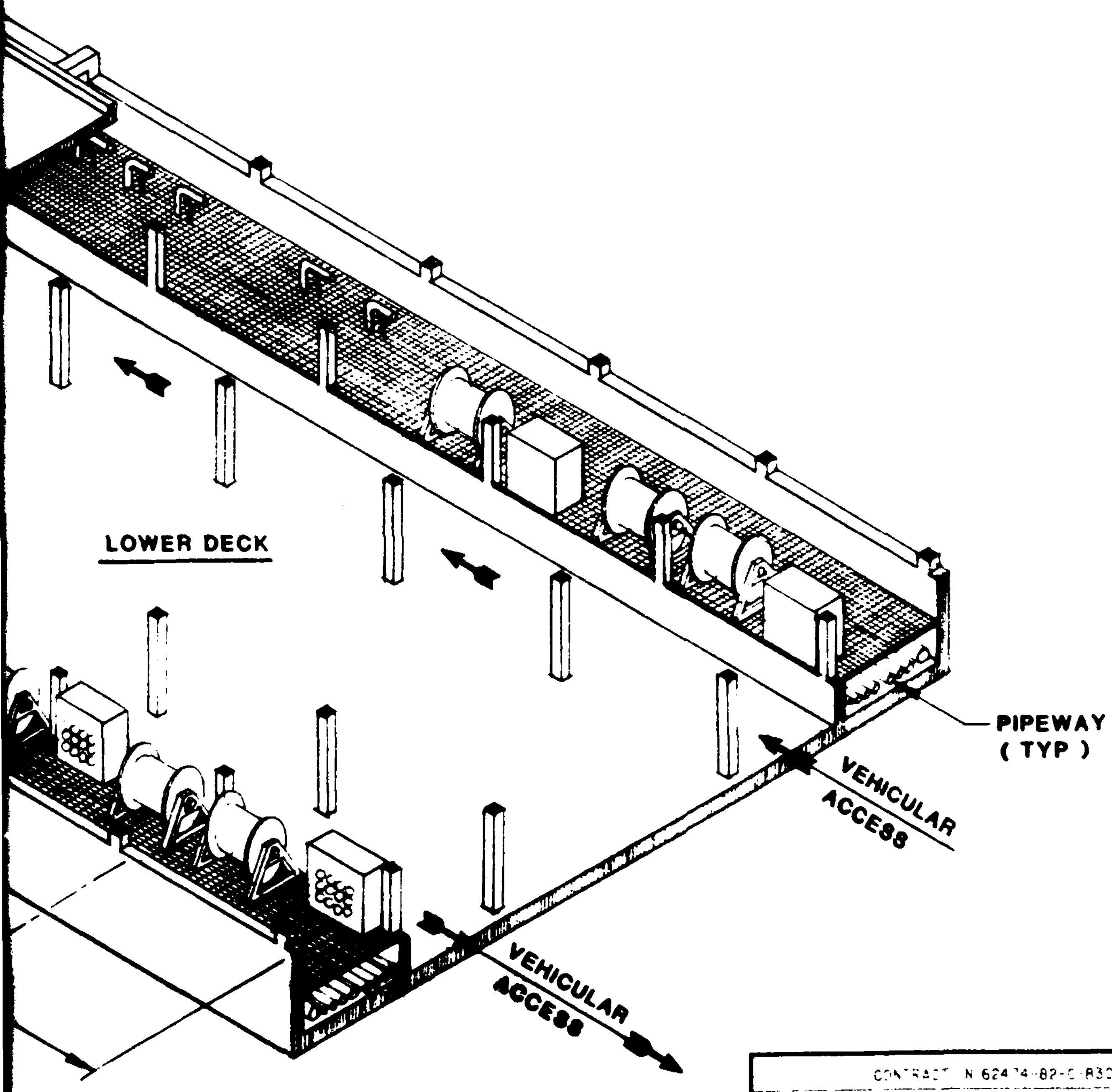


MECHANICAL GALLERY SECTION

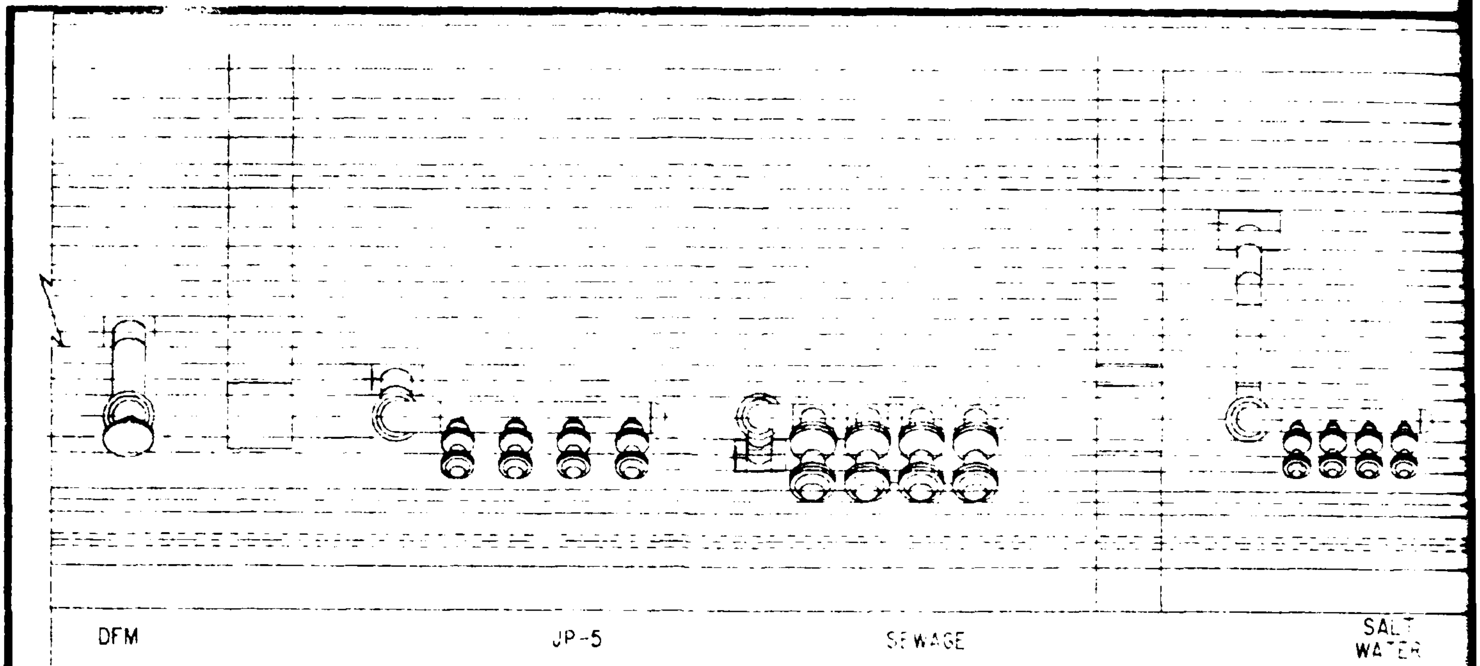
0 1 2 3 4 5 6 7 8 9 10

CONTRACT N 62474-82-C-8303	
CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY	
PILE SUPPORTED PIER GALLERY SECTIONS	DRAWING NO. 2
BROWN & ROOT DEVELOPMENT, INC.	

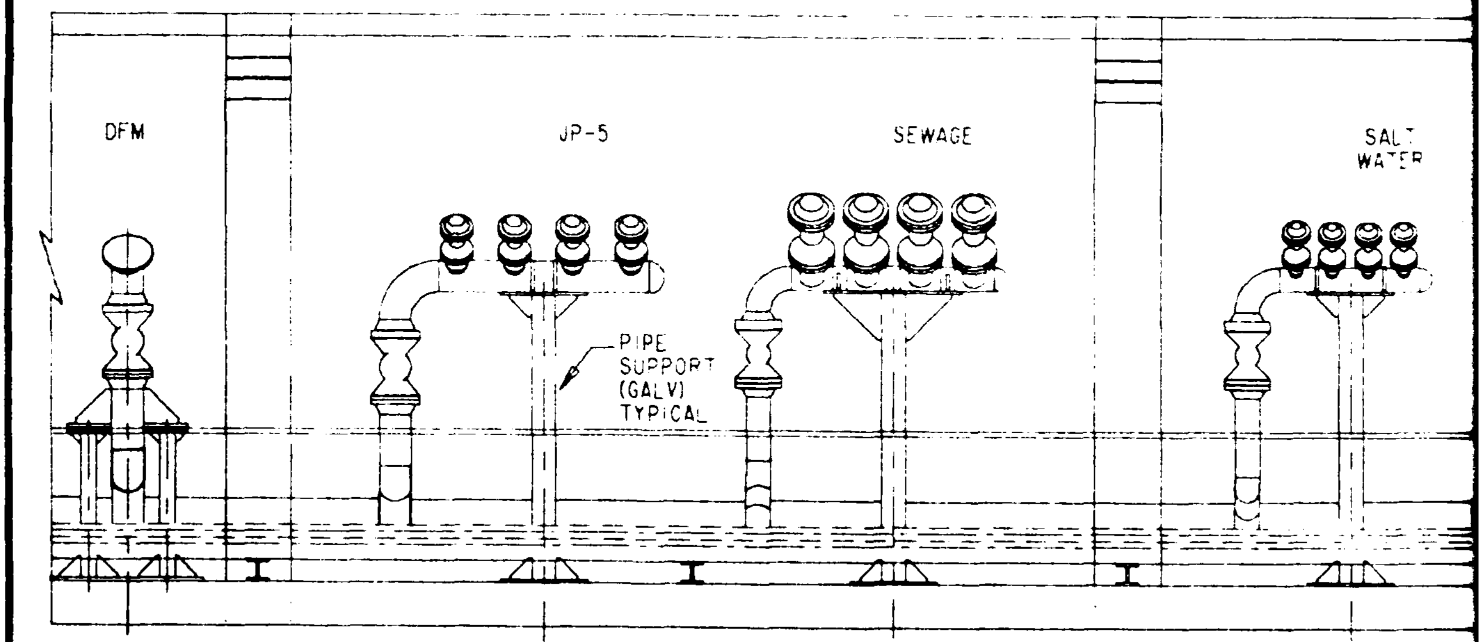

TOP DECK
MECHANICAL STATIONS
(TYP)
ELECTRICAL STATIONS
(TYP)
℄ OF 600 FT. PIER
LO



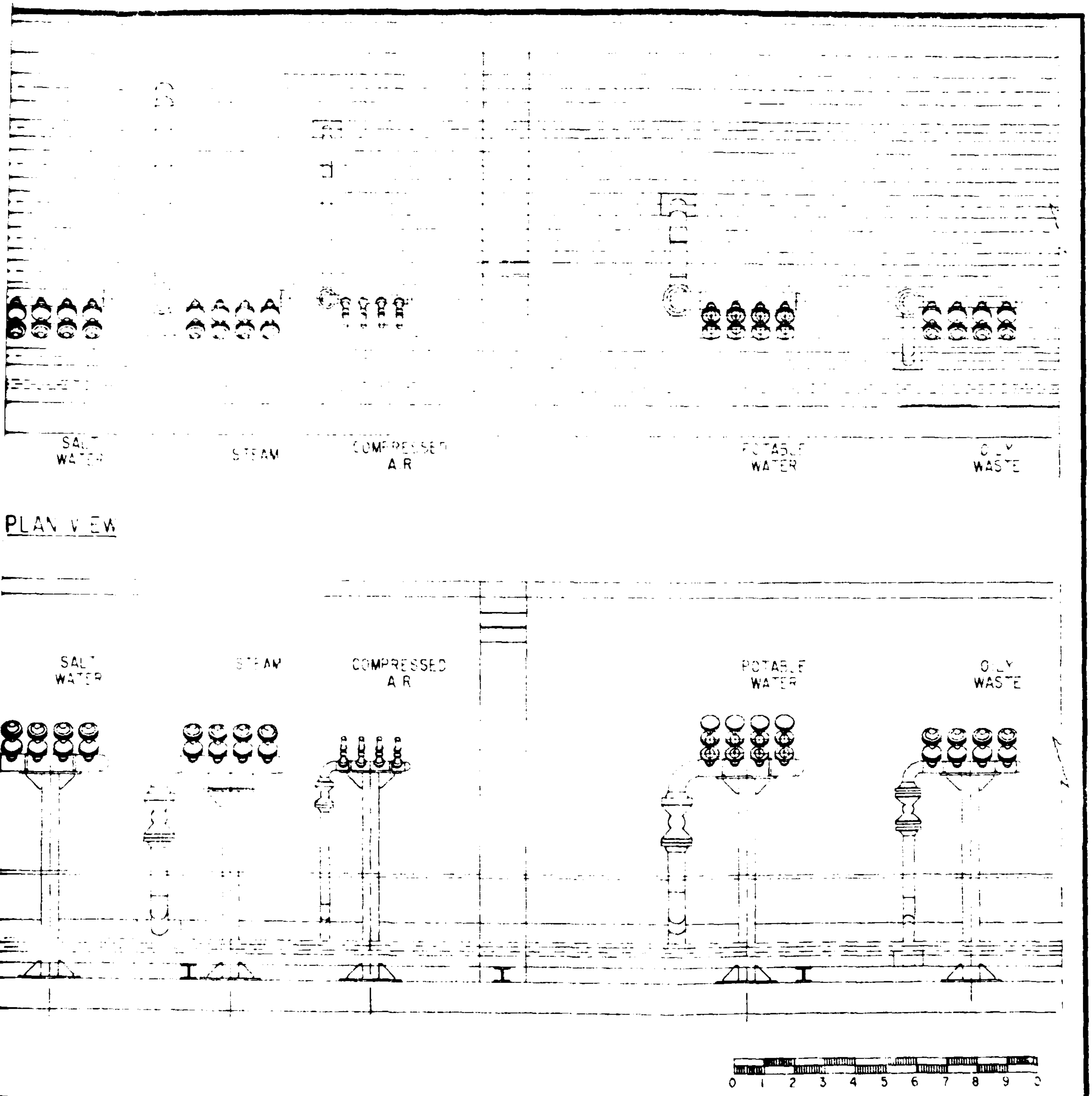
CONTRACT N 62474-82-C-8303	
CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY	
PILE SUPPORTED PIER GALLERY PERSPECTIVE	DRAWING NO 3
BROWN & ROOT DEVELOPMENT INC	



PLAN VIEW



ELEVATION



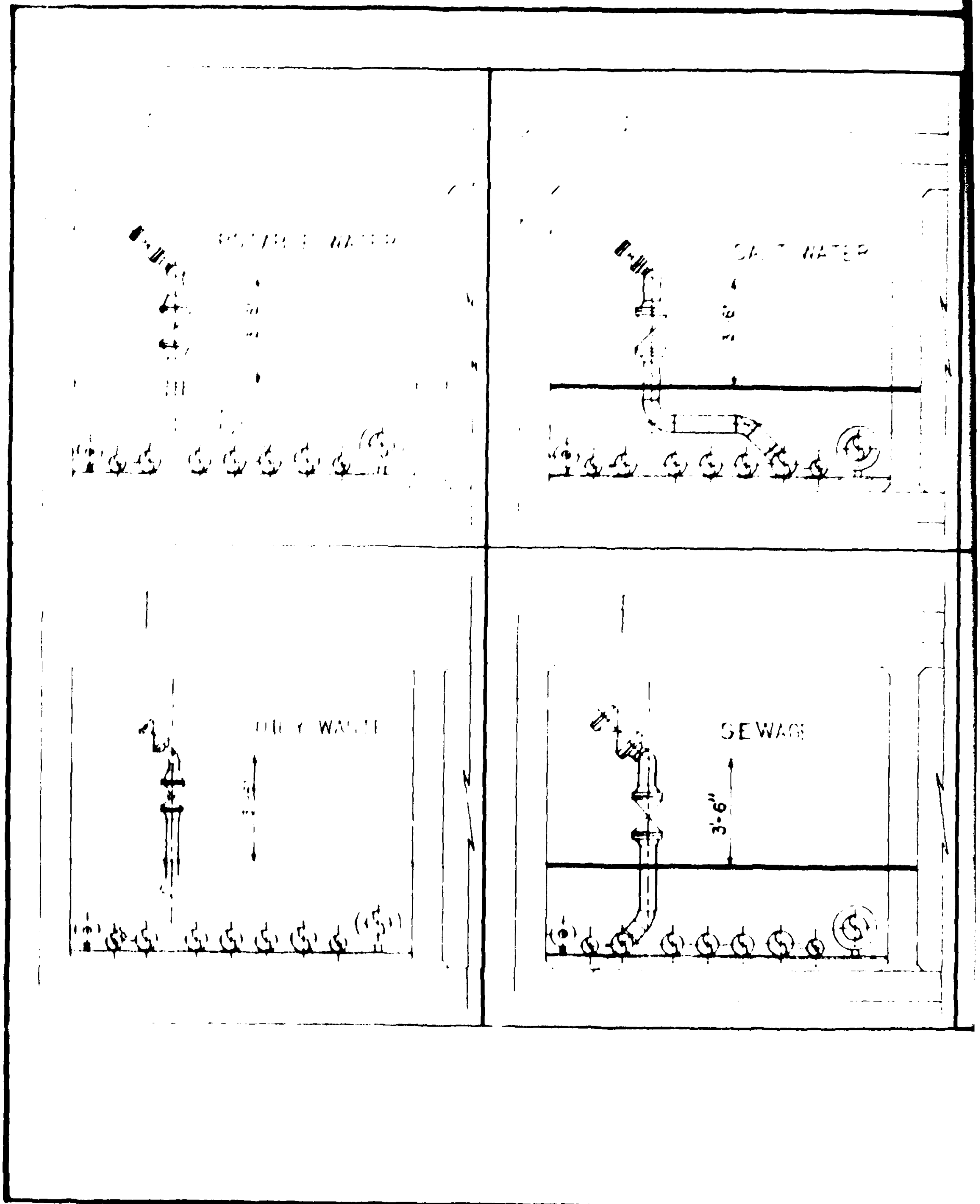
CONTRACT N 62474-82-C-8303

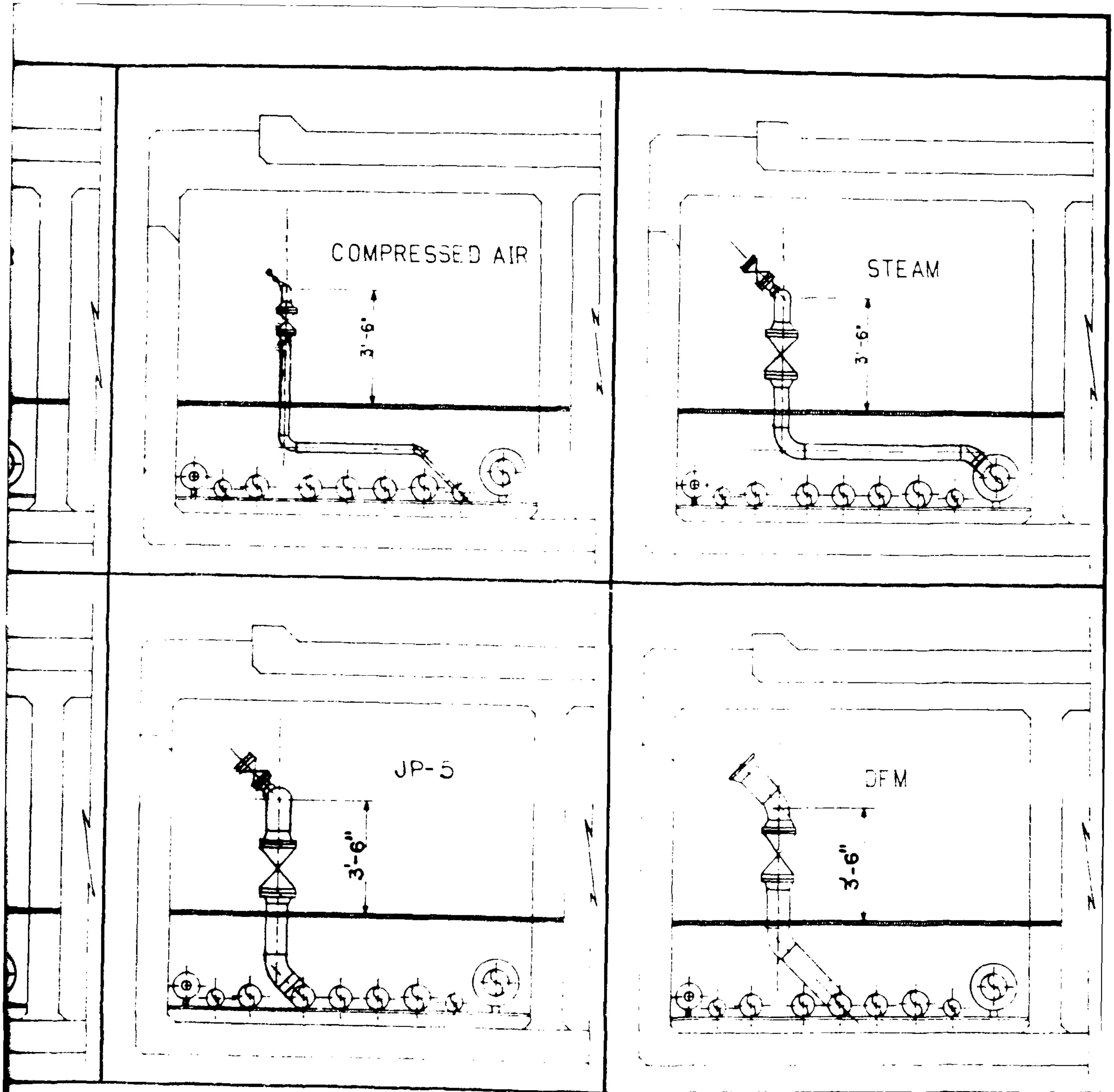
CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY

PILE SUPPORTED PIER
UTILITY STATIONS, PLAN & ELEV.

DRAWING NO. 4

BROWN & ROOT DEVELOPMENT INC.


3'-6"



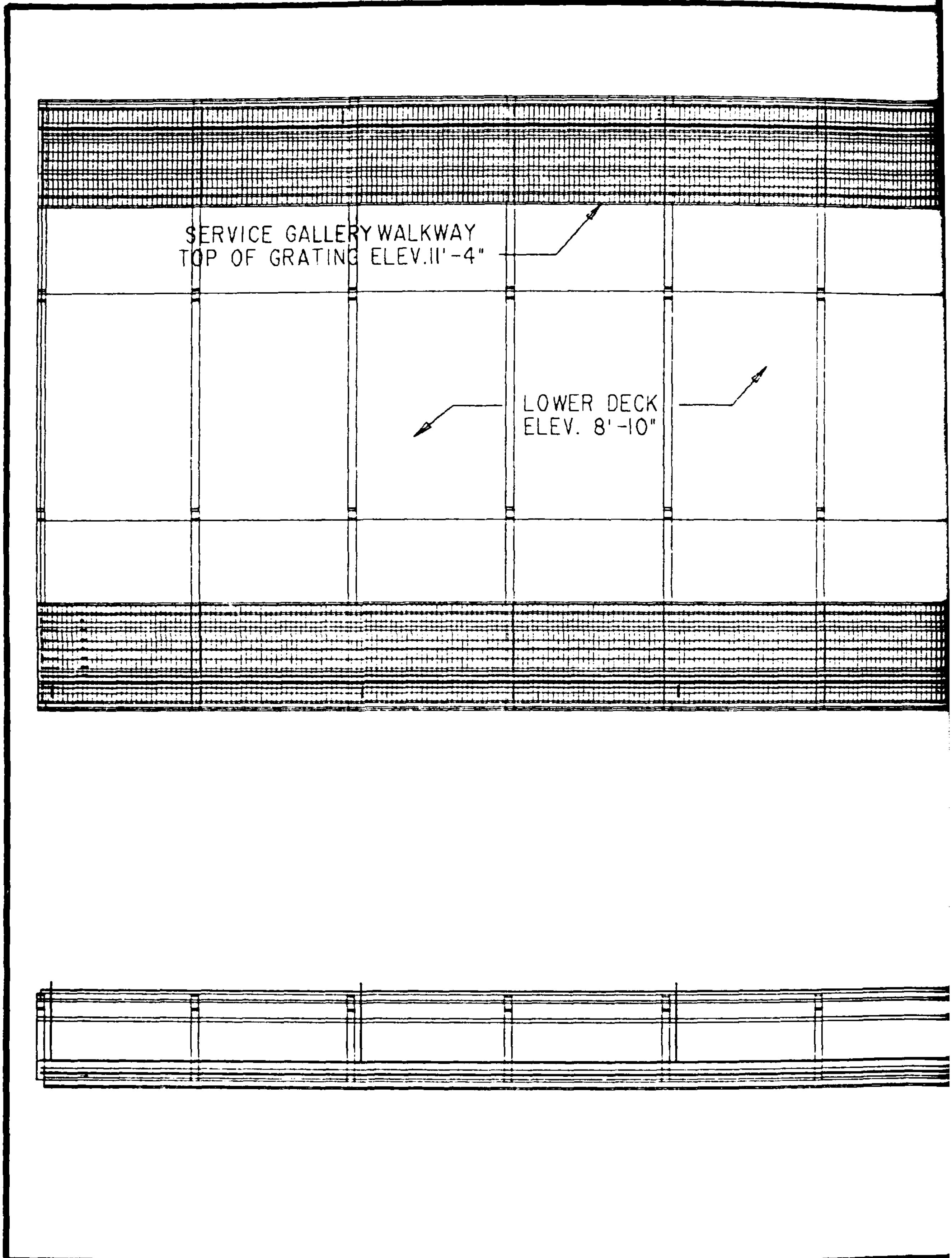
CONTRACT N 62474-82-C-8303

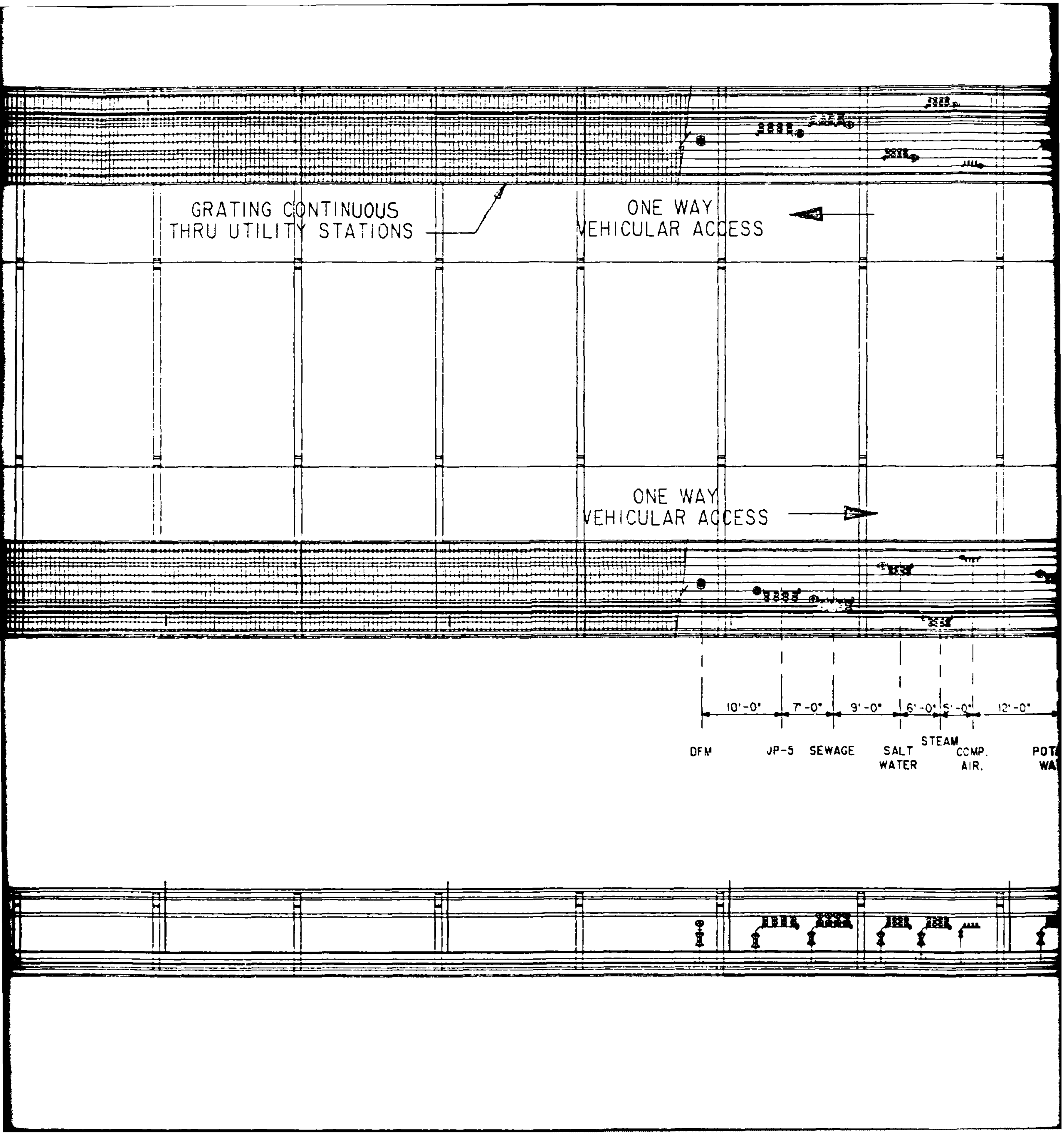
CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY

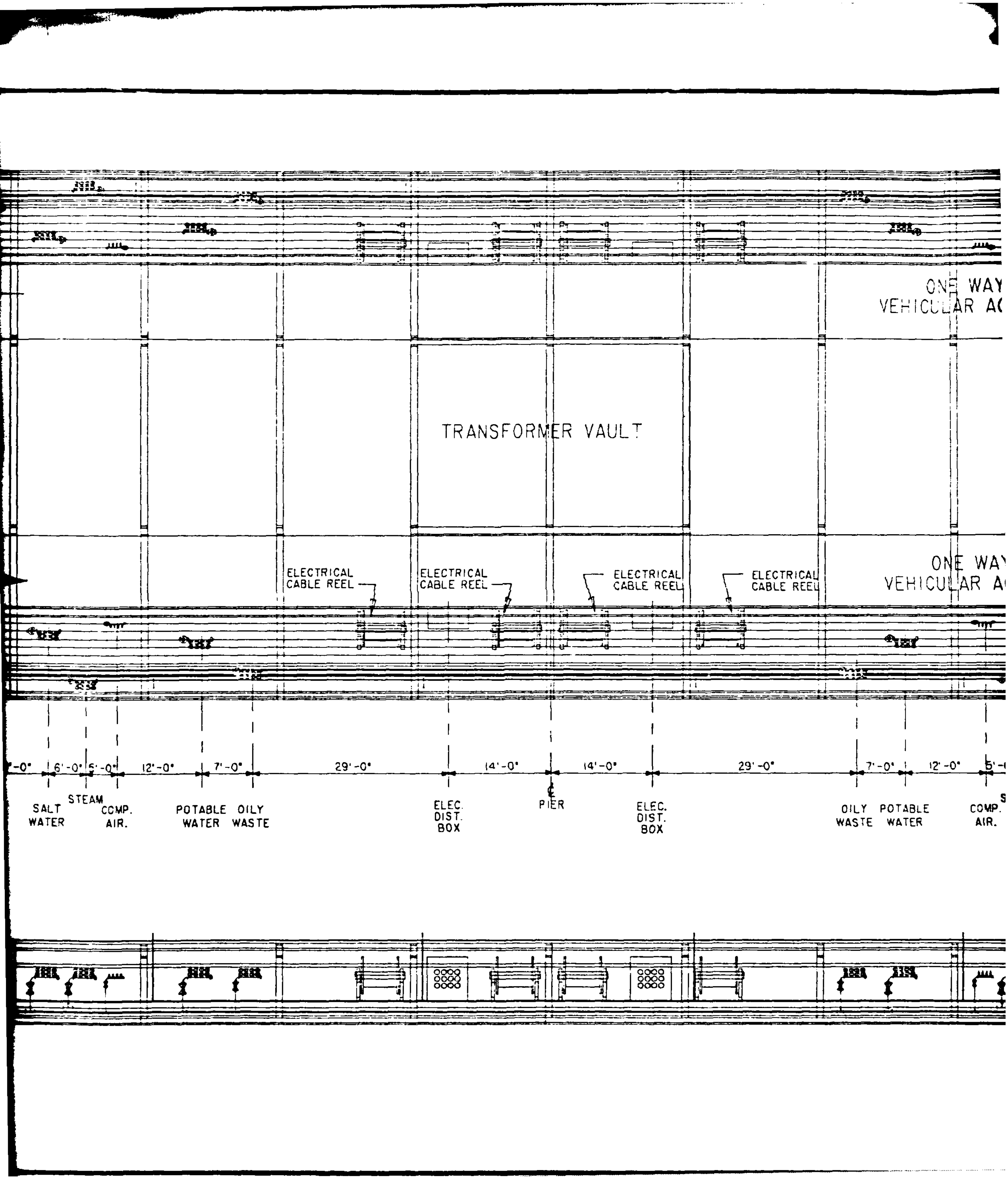
PILE SUPPORTED PIER
UTILITY STATIONS, SECTIONS

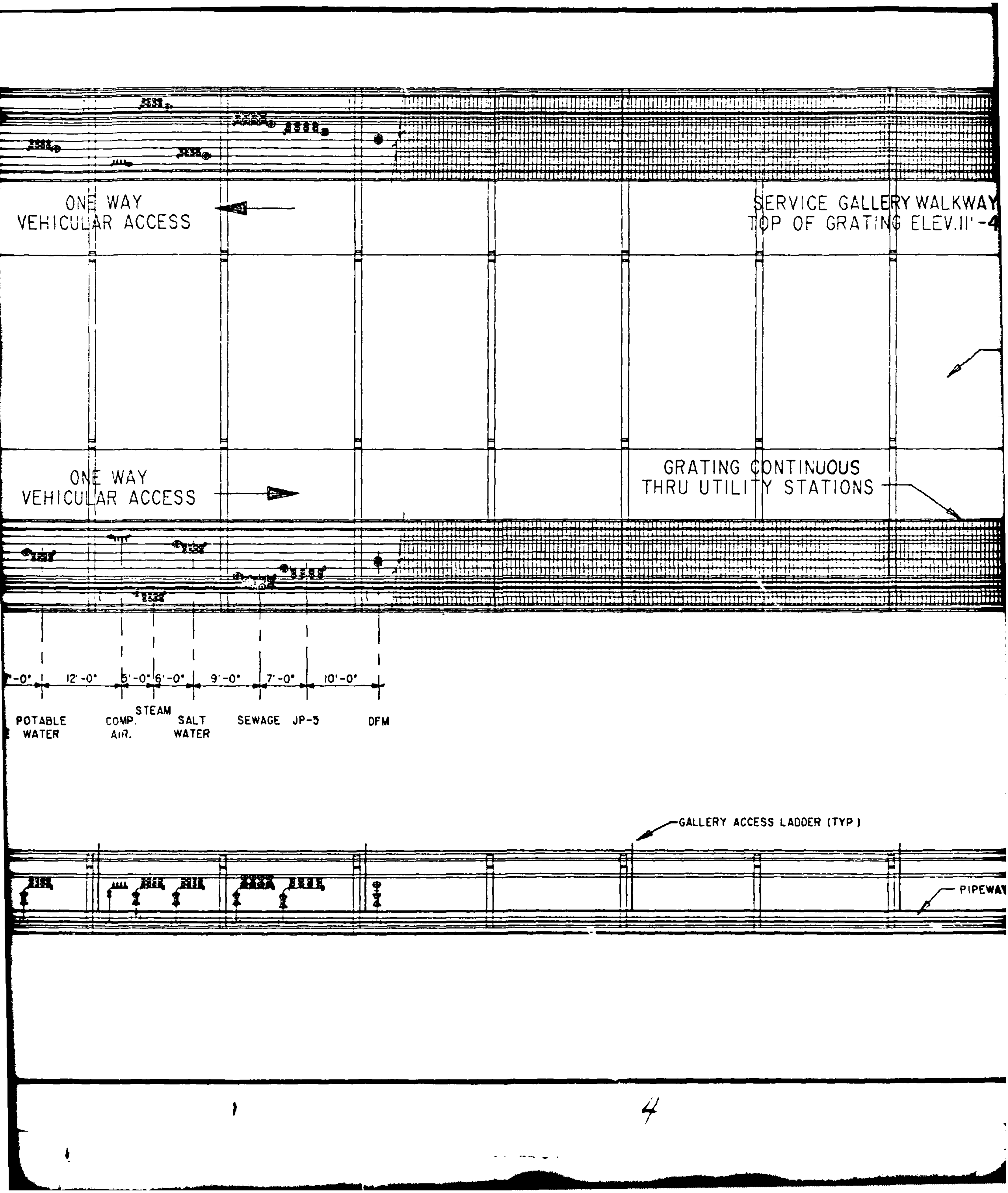
DRAWING NO. 5

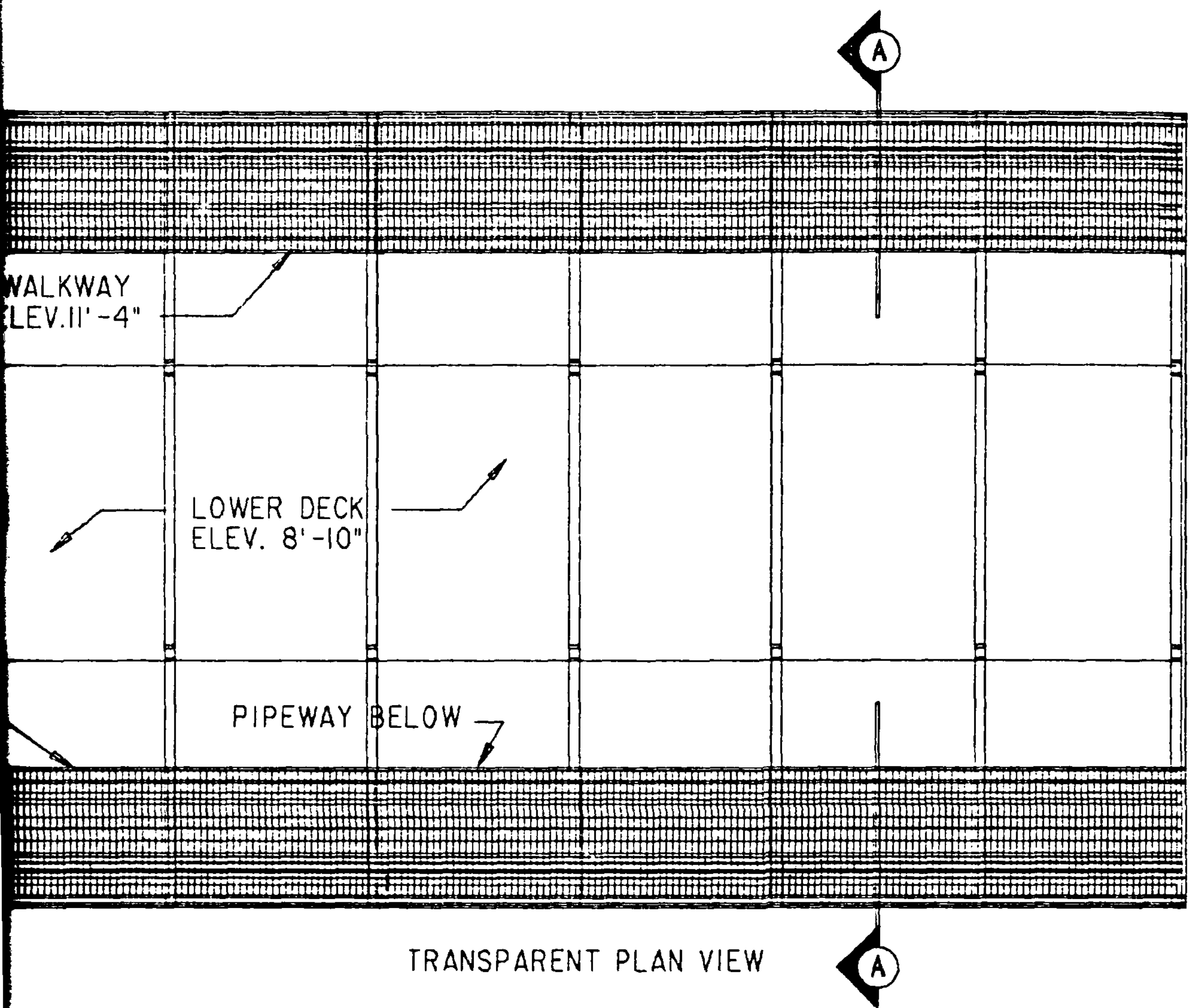
BROWN & ROOT DEVELOPMENT, INC.


SERVICE GALLERY WALKWAY
TOP OF GRATING ELEV. 11'-4"
LOWER DECK
ELEV. 8'-10"

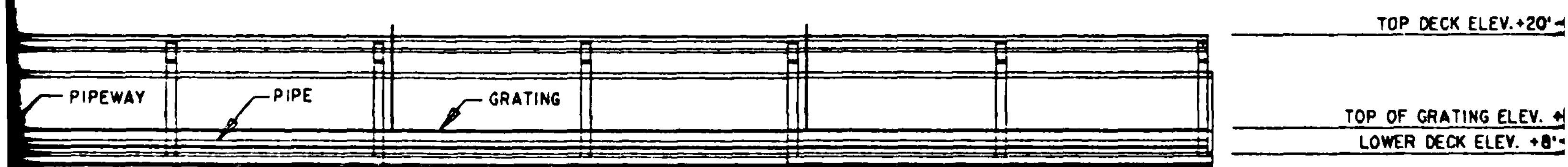

GRATING CONTINUOUS
THRU UTILITY STATIONS
ONE WAY
VEHICULAR ACCESS
ONE WAY
VEHICULAR ACCESS
10'-0"
7'-0"
9'-0"
6'-0"
5'-0"
12'-0"
DFM
JP-5
SEWAGE
SALT
WATER
STEAM
COMP.
AIR.


ONE WAY
VEHICULAR A
TRANSFORMER VAULT
ONE WAY
VEHICULAR A
ELECTRICAL CABLE REEL
ELECTRICAL CABLE REEL
ELECTRICAL CABLE REEL
ELECTRICAL CABLE REEL
-0"
6'-0"
5'-0"
12'-0"
7'-0"
29'-0"
14'-0"
14'-0"
29'-0"
7'-0"
12'-0"
5'-
SALT WATER
STEAM
COMP. AIR.
POTABLE WATER
OILY WASTE
ELEC. DIST. BOX
℄ PIER
ELEC. DIST. BOX
OILY WASTE
POTABLE WATER
COMP. AIR.

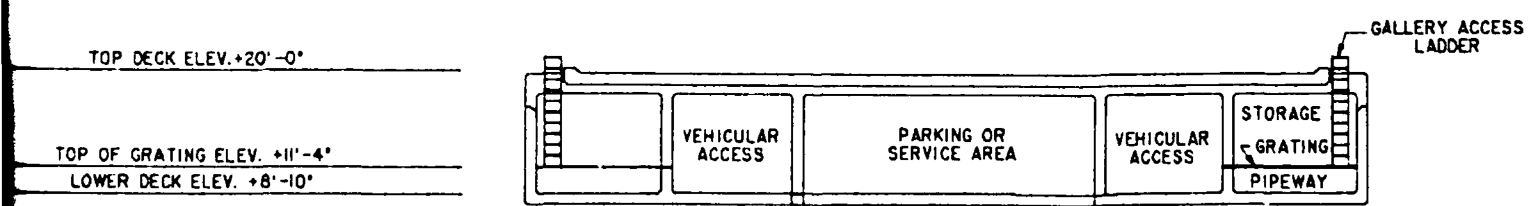

ONE WAY
VEHICULAR ACCESS
SERVICE GALLERY WALKWAY
TOP OF GRATING ELEV.11'-4
ONE WAY
VEHICULAR ACCESS
GRATING CONTINUOUS
THRU UTILITY STATIONS
-0"
12'-0"
5'-0"
6'-0"
9'-0"
7'-0"
10'-0"
POTABLE
WATER
COMP.
AIR.
STEAM
SALT
WATER
SEWAGE
JP-5
DFM
GALLERY ACCESS LADDER (TYP)
PIPEWAY



TRANSPARENT PLAN VIEW

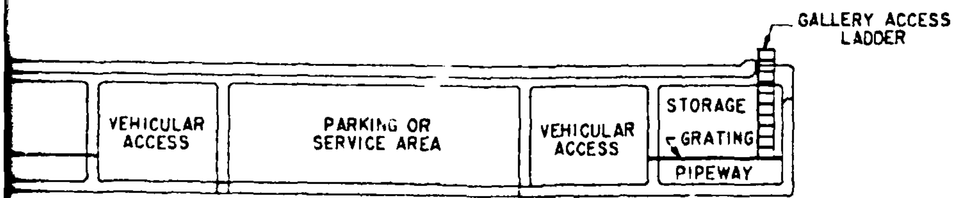


TRANSPARENT ELEVATION VIEW

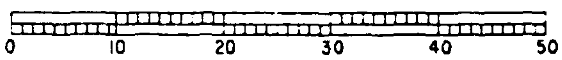


END SECTION VIEW A-A

PILE
PLA



END SECTION VIEW A-A

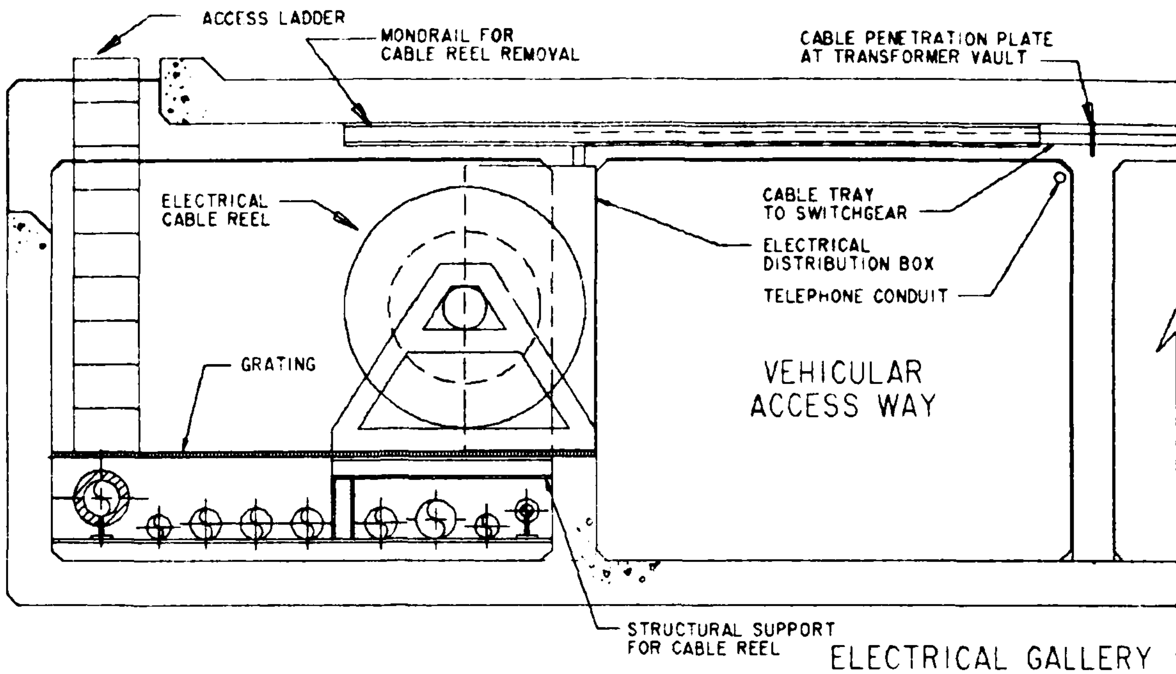


CONTRACT N 62474-82-C-8303

CONCEPTUAL AND DEFINITIVE DESIGNS
FOR BERTHING PIER UTILITY GALLERY

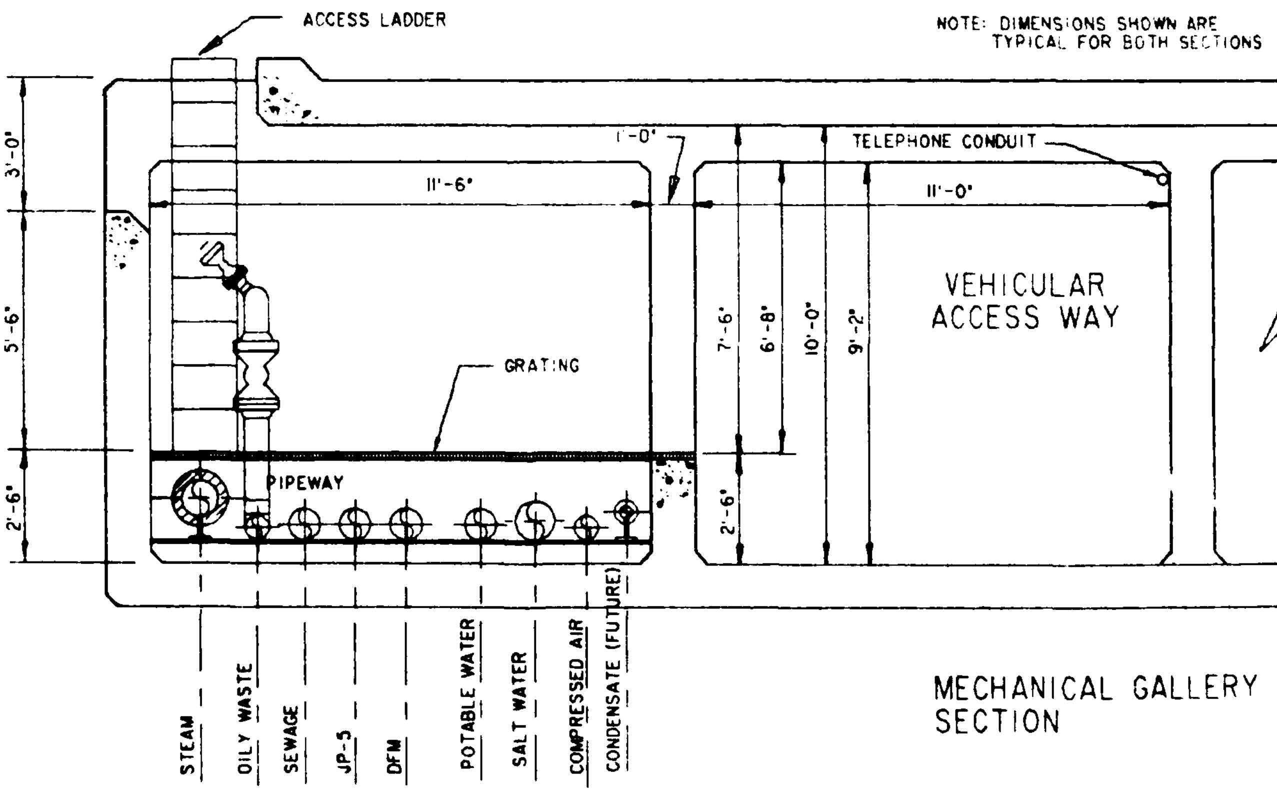
PILE SUPPORTED PIER-ALTERNATE PLAN, ELEVATION & SECTION	DRAWING NO. 6

BROWN & ROOT DEVELOPMENT, INC.

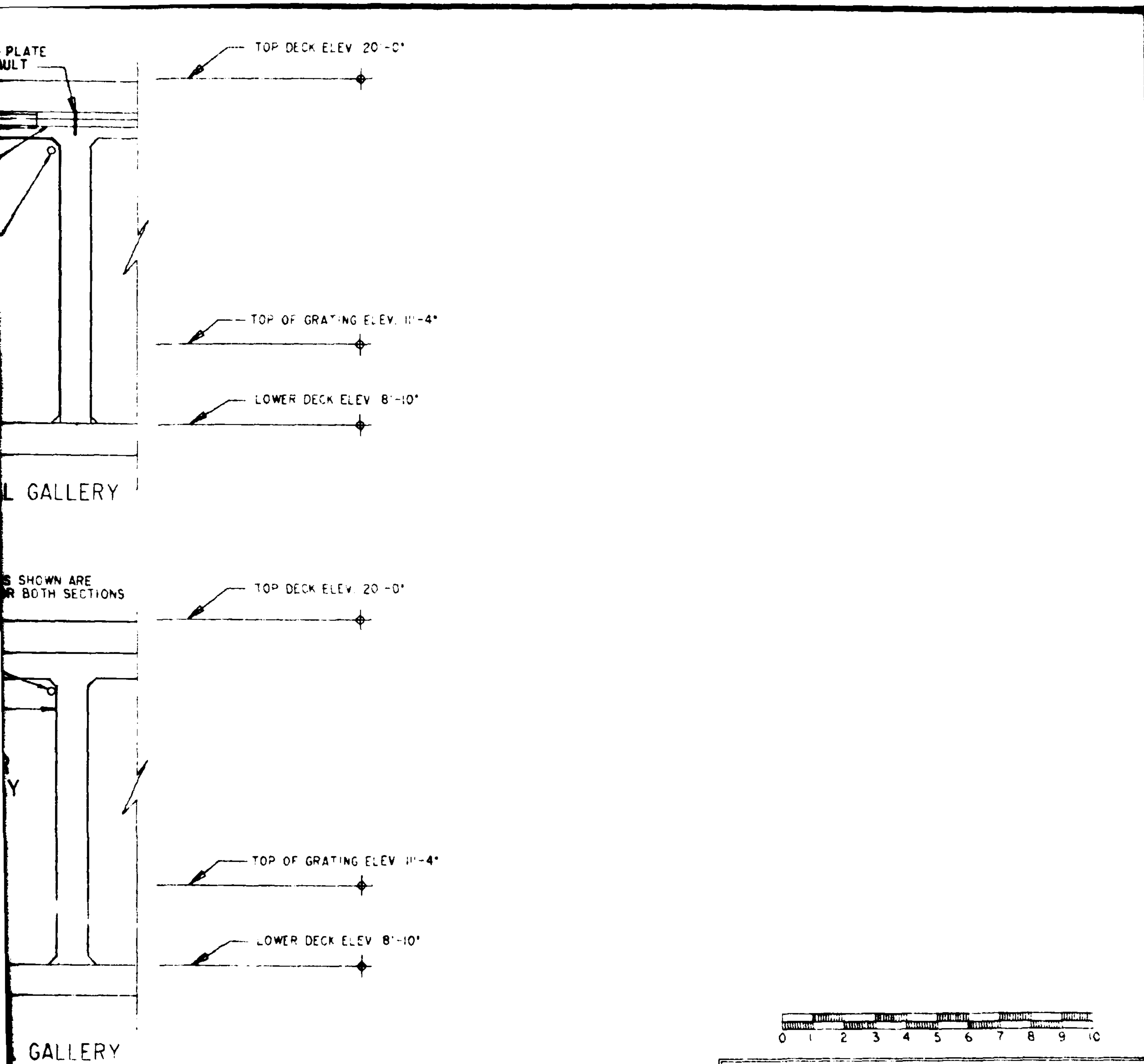


ELECTRICAL GALLERY SECTION

NOTE: DIMENSIONS SHOWN ARE TYPICAL FOR BOTH SECTIONS



MECHANICAL GALLERY SECTION

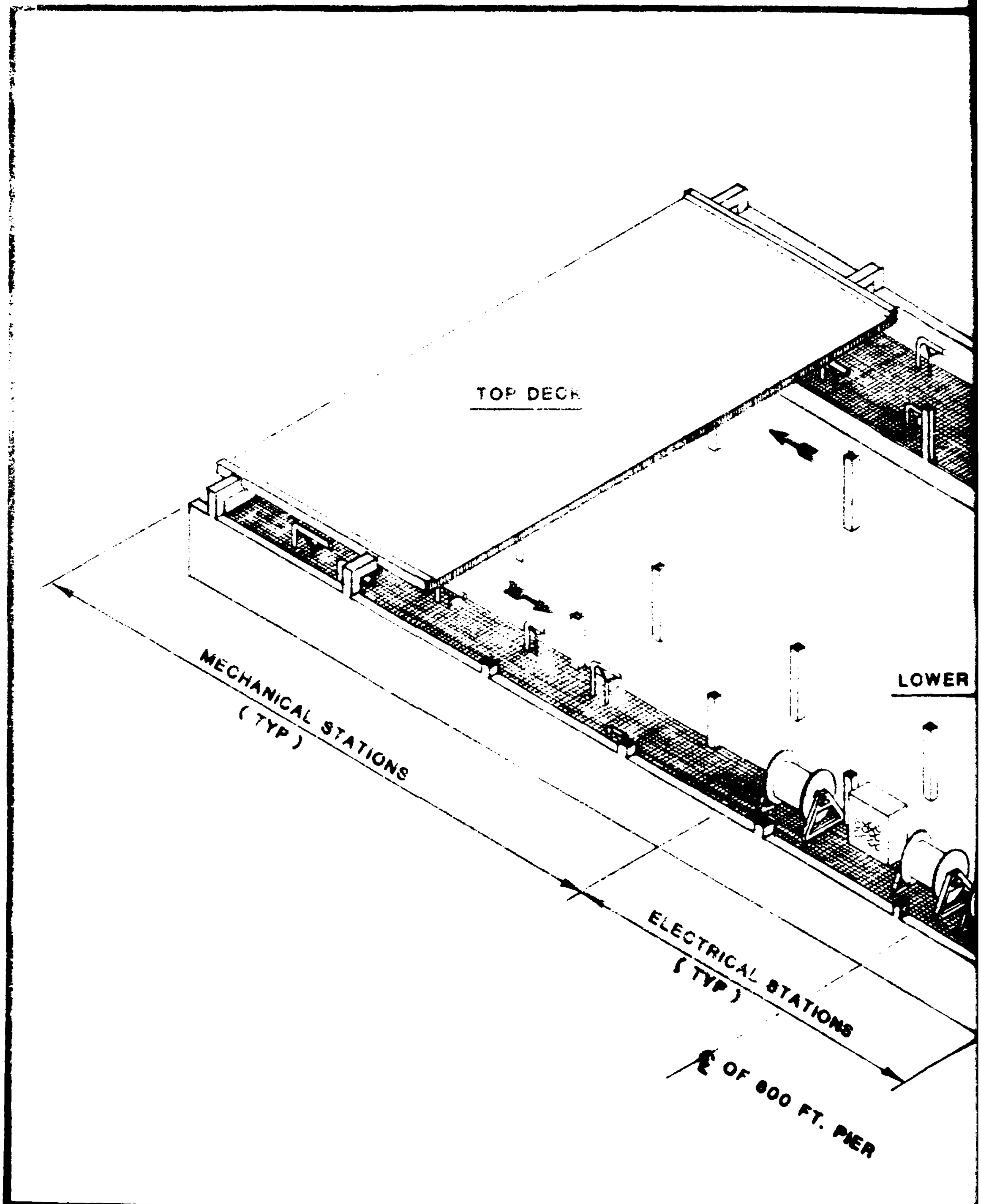


CONTRACT N 62474-82-C-8303

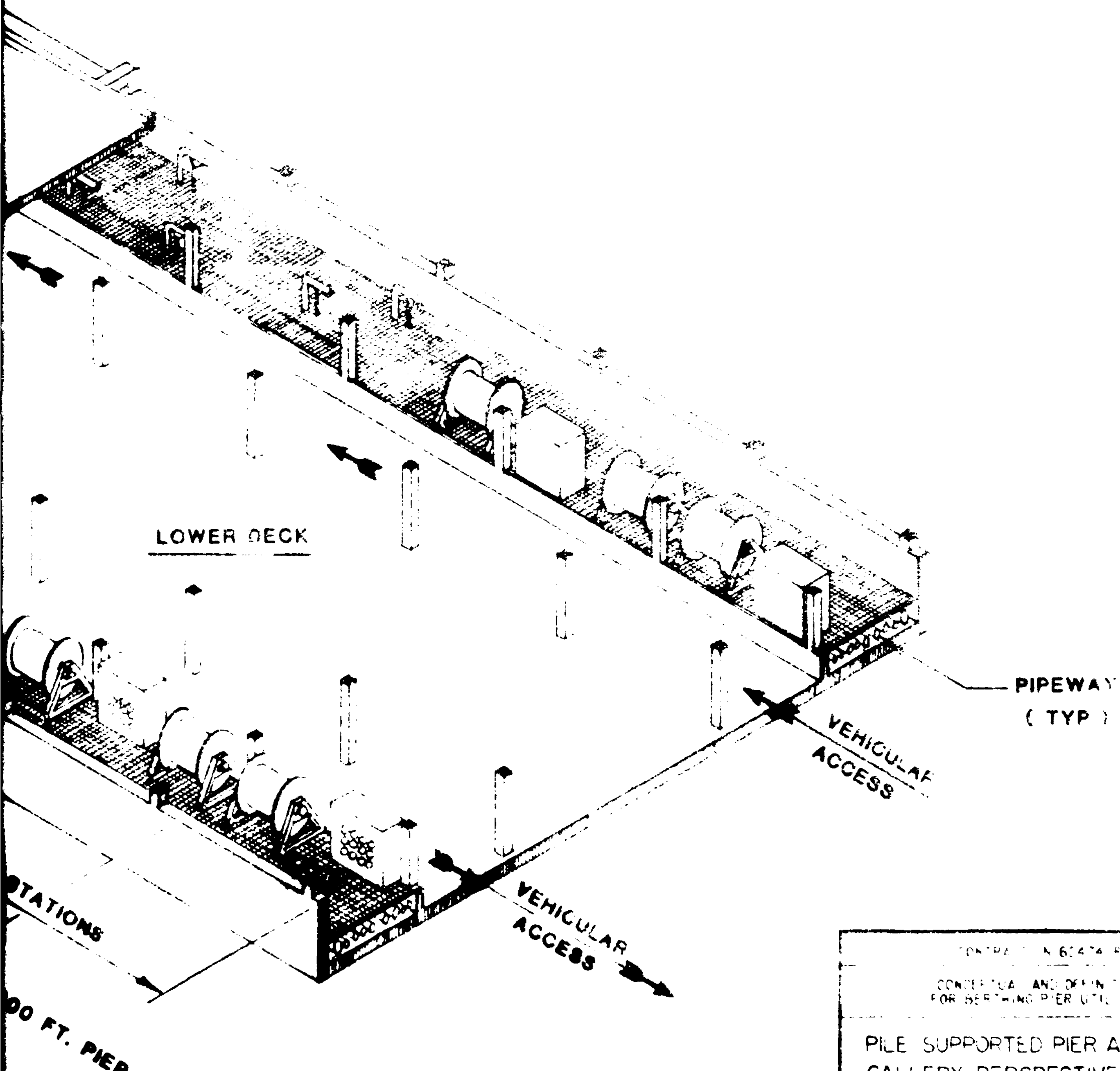
CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY

PILE SUPPORTED PIER ALTERNATE GALLERY SECTIONS	DRAWING NO 7

BROWN & ROOT DEVELOPMENT, INC



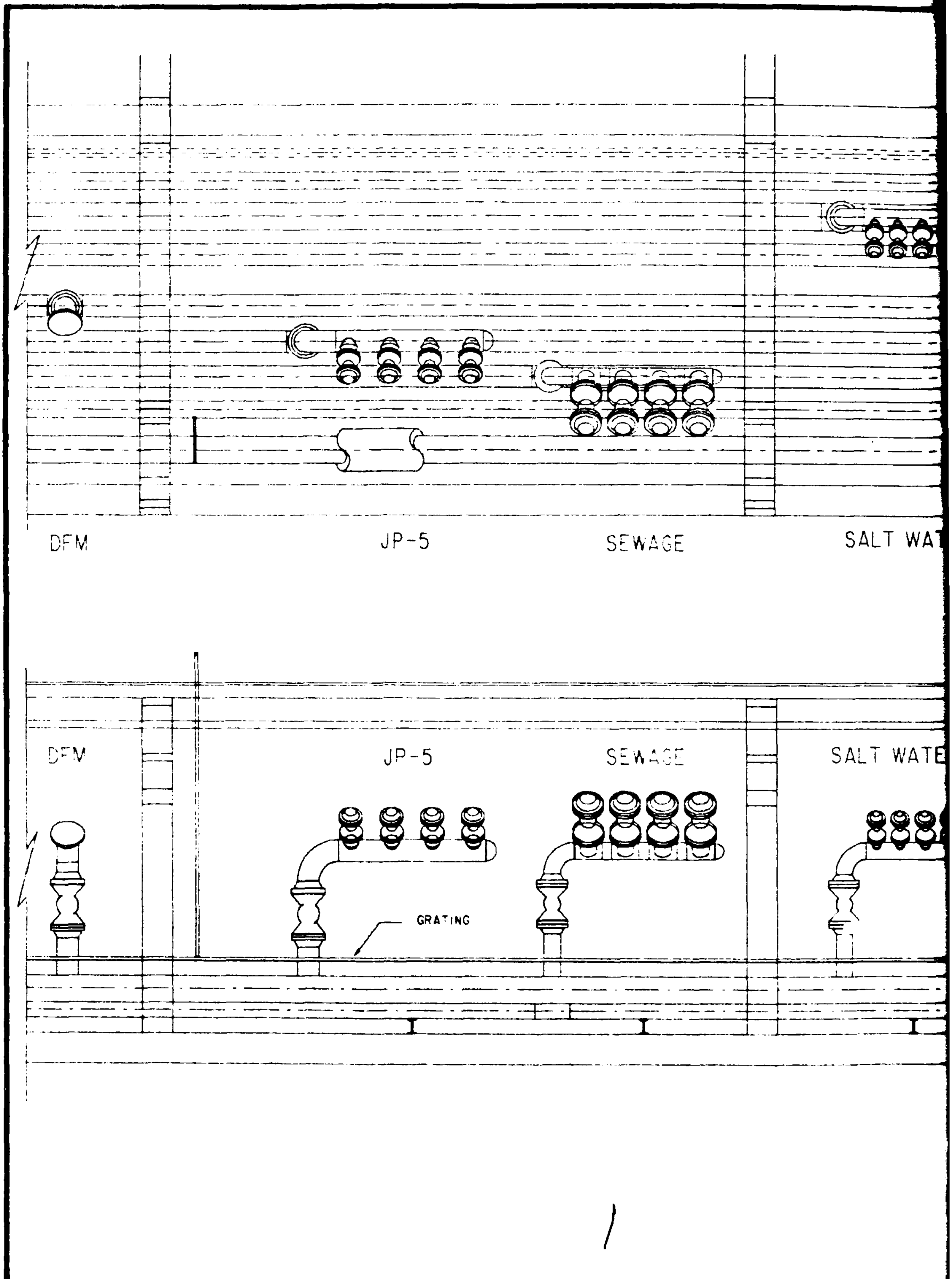
TOP DECK
LOWER
MECHANICAL STATIONS
(TYP)
ELECTRICAL STATIONS
(TYP)
℄ OF 800 FT. PIER



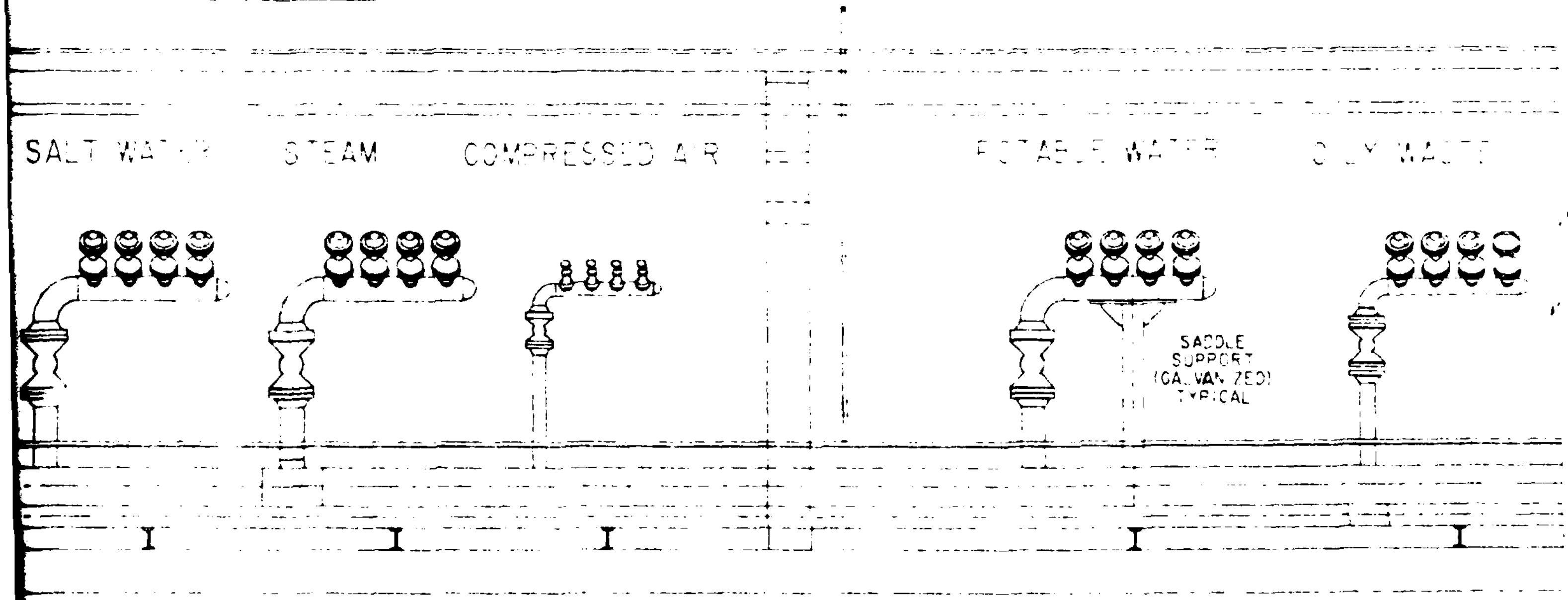
CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY

PILE SUPPORTED PIER ALTERNATE GALLERY PERSPECTIVE

BROWN & ROOT DEVELOPMENT, INC


DFM
JP-5
SEWAGE
SALT WAT
DFM
JP-5
SEWAGE
SALT WATE
GRATING

PLAN VIEW



ELEVATION

0 1 2 3 4 5 6 7 8 9 10

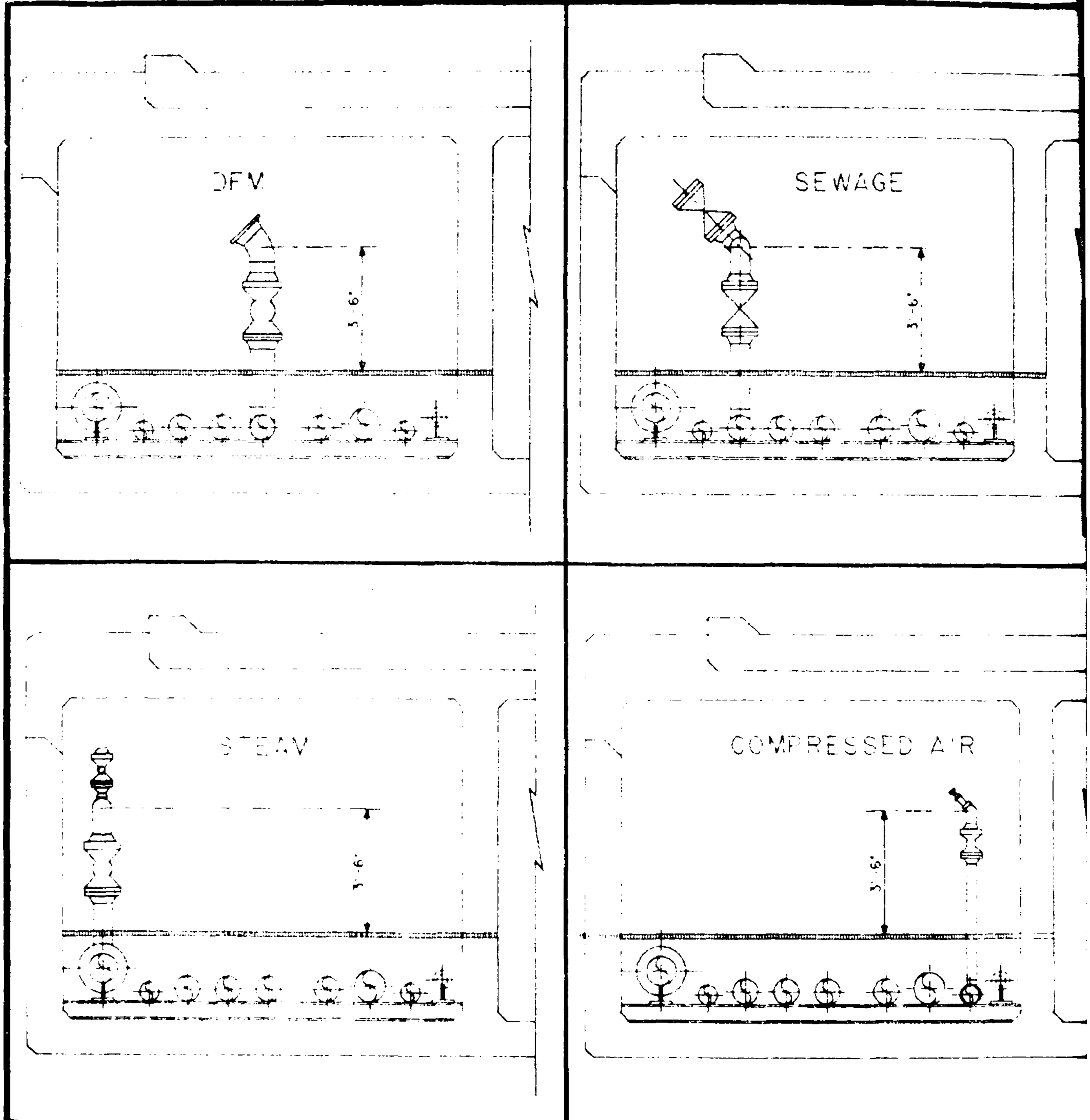
CONTRACT N 62474-82-C-8303

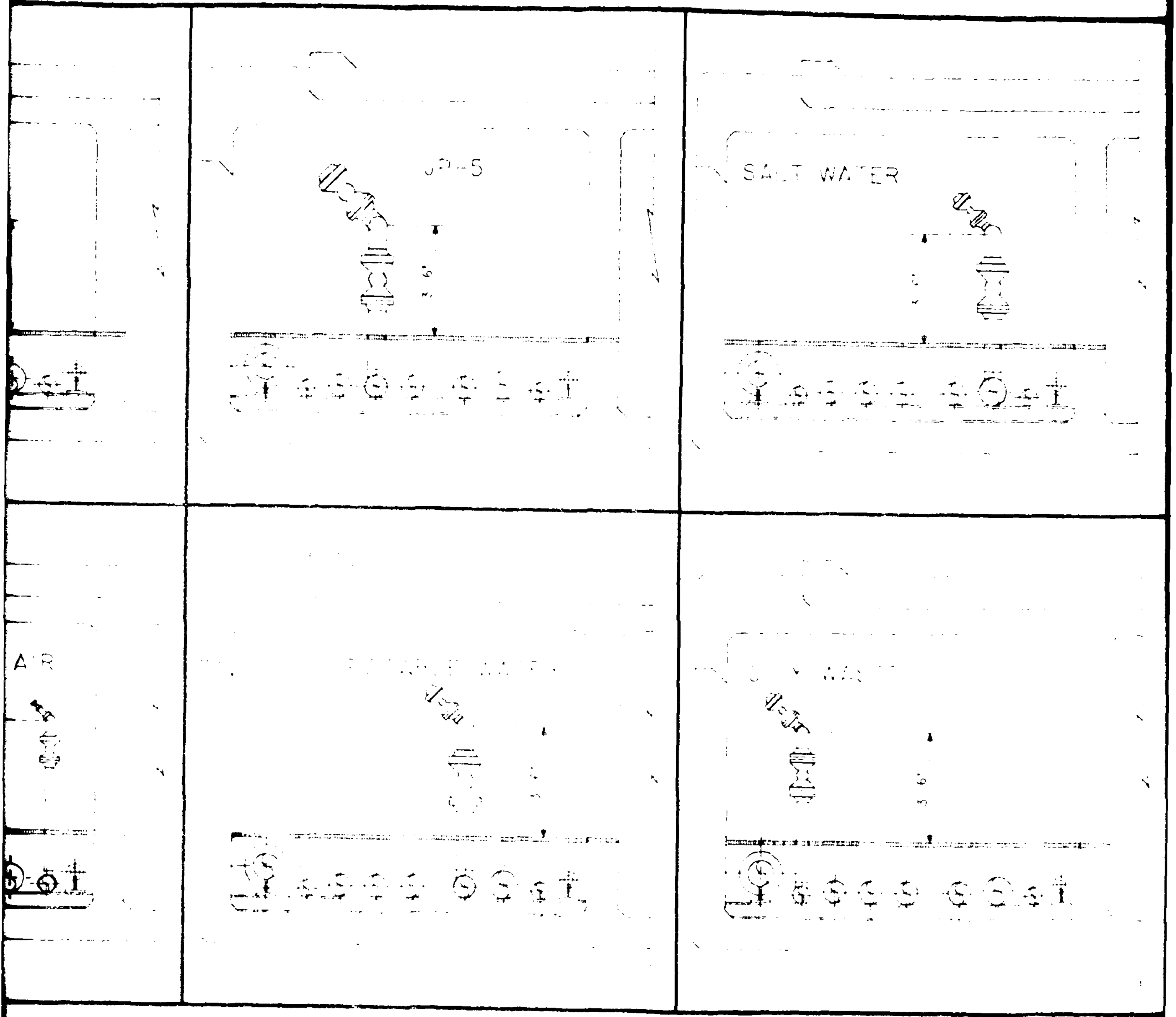
CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY

PILE SUPPORTED PIER ALTERNATE UTILITY STATIONS, PLAN & ELEV.

DRAWING NO 9

BROWN & ROOT DEVELOPMENT, INC


DFM
3'-6"
SEWAGE
3'-6"
STEAM
3'-6"
COMPRESSED AIR
3'-6"



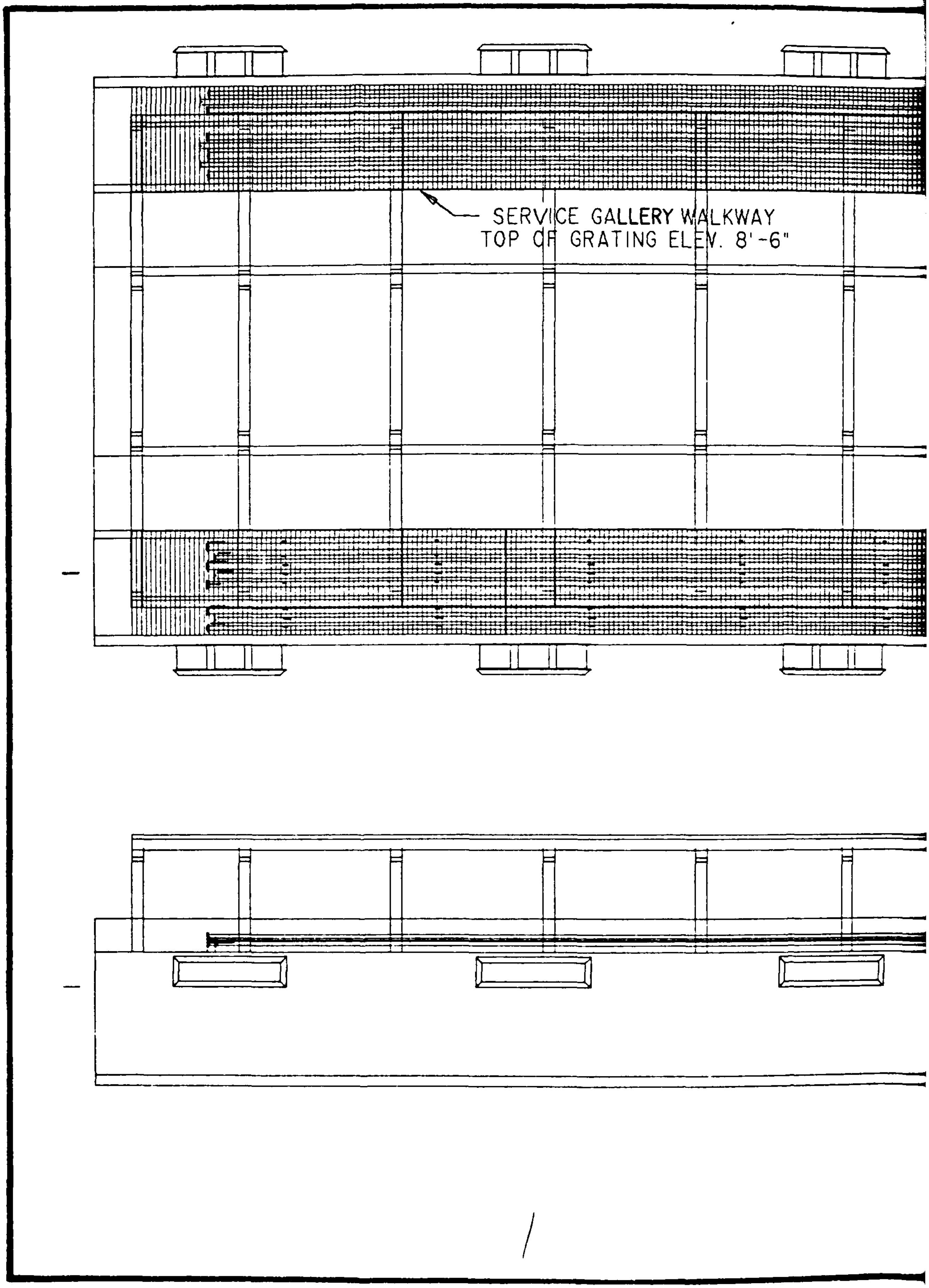
CONTRACT N 62474-82 C-8303

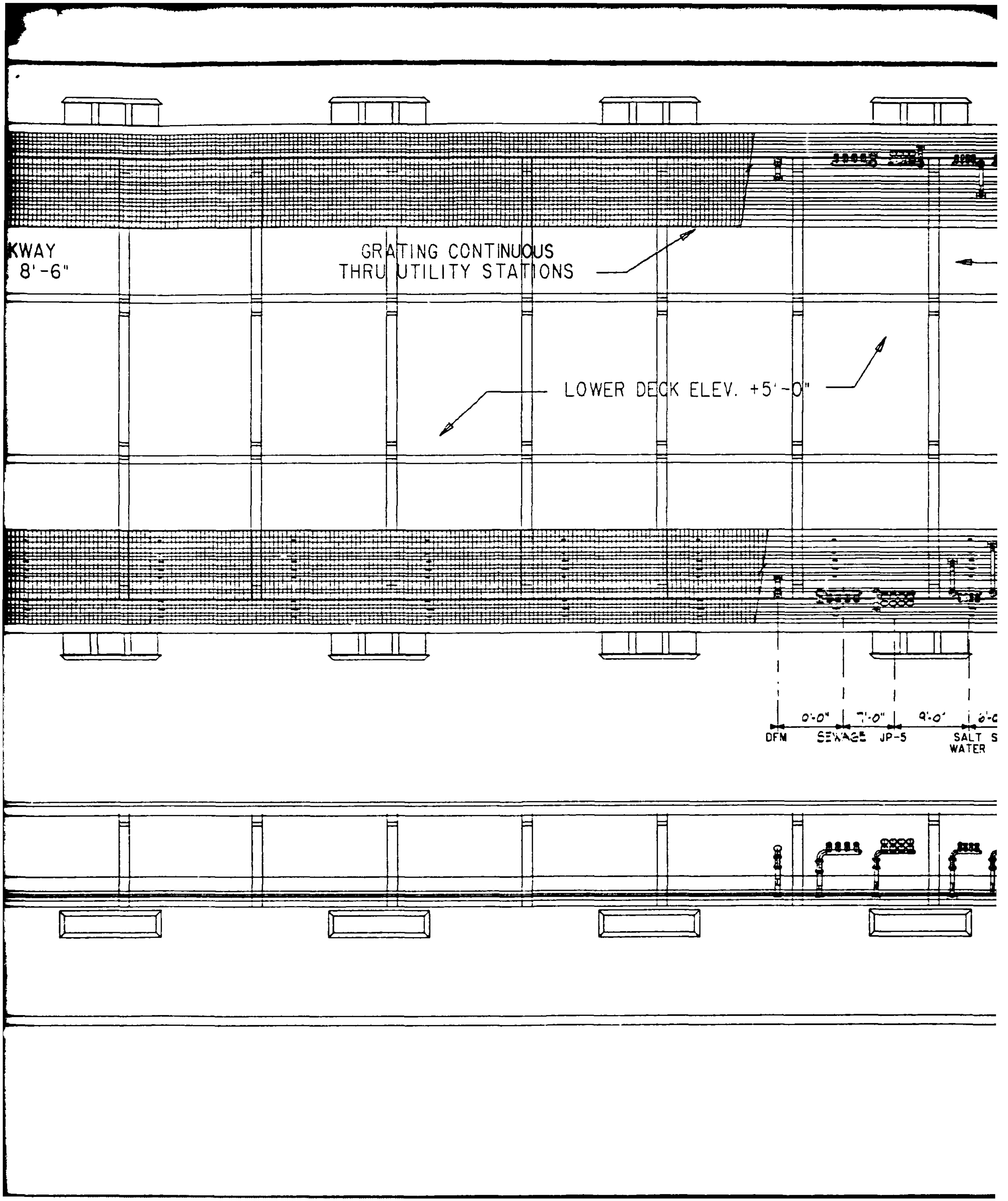
CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY

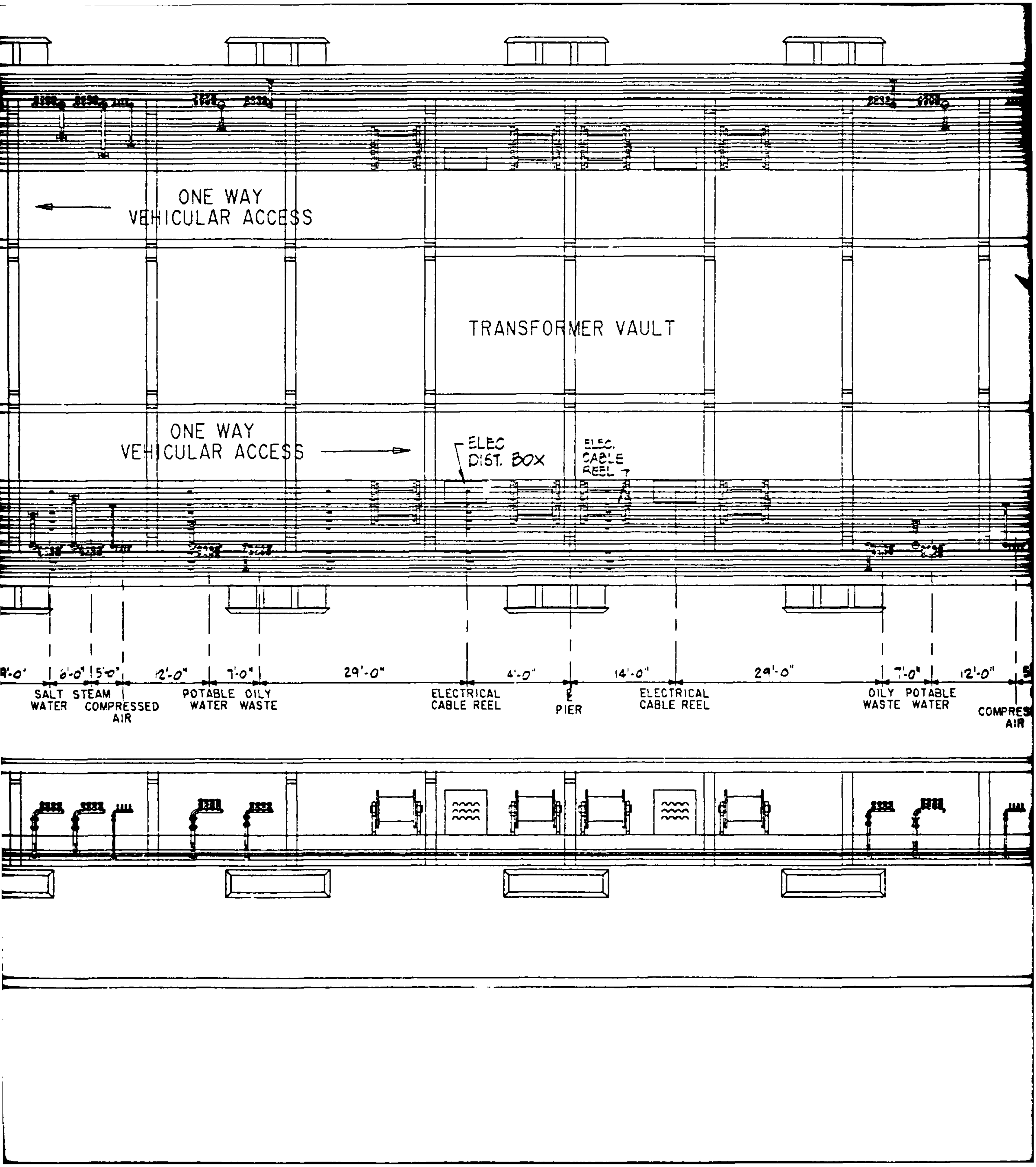
PILE SUPPORTED PIER-ALTERNATE UTILITY STATIONS, SECTIONS

DRAWING NO 10

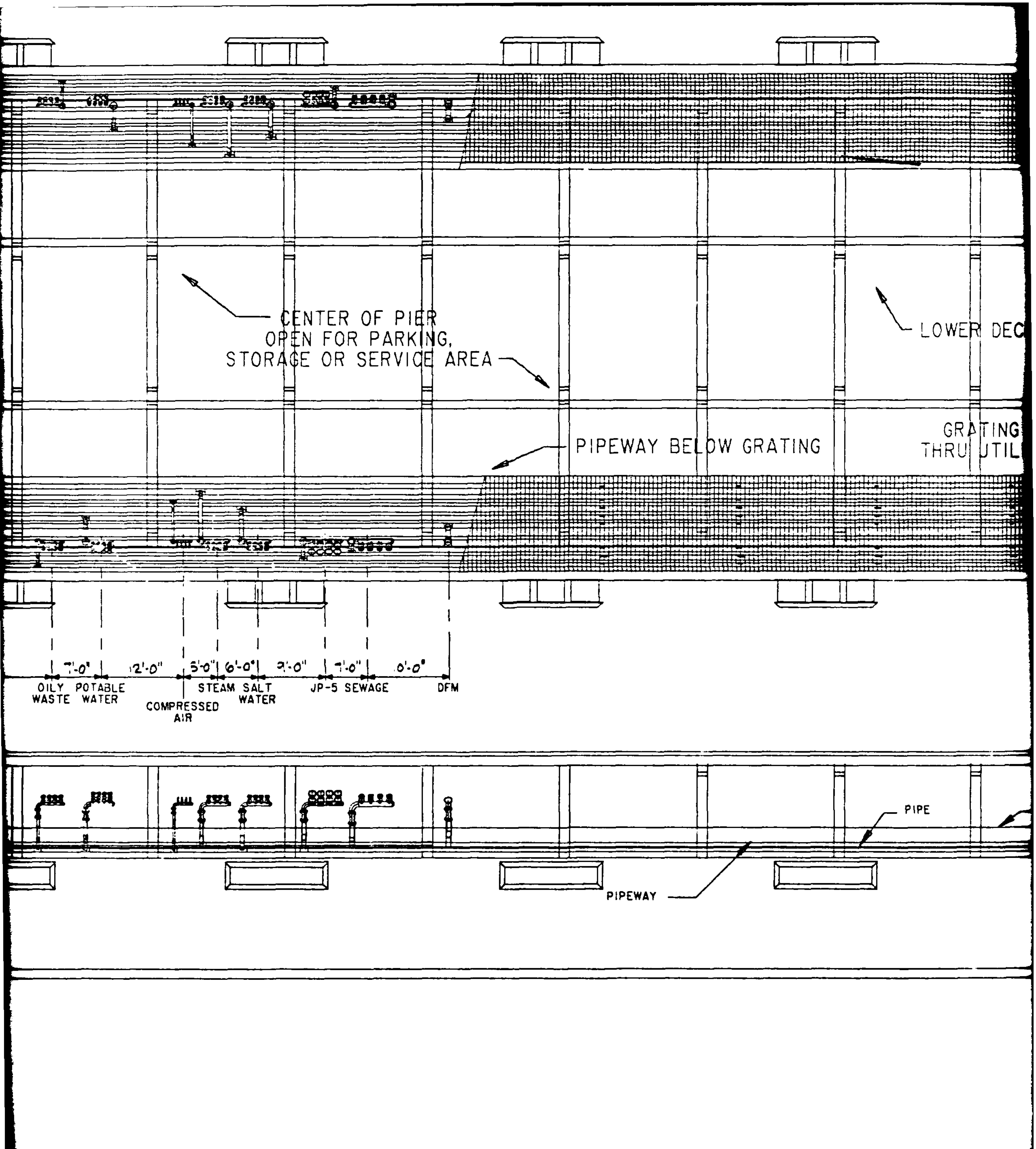
BROWN & ROOT DEVELOPMENT, INC.

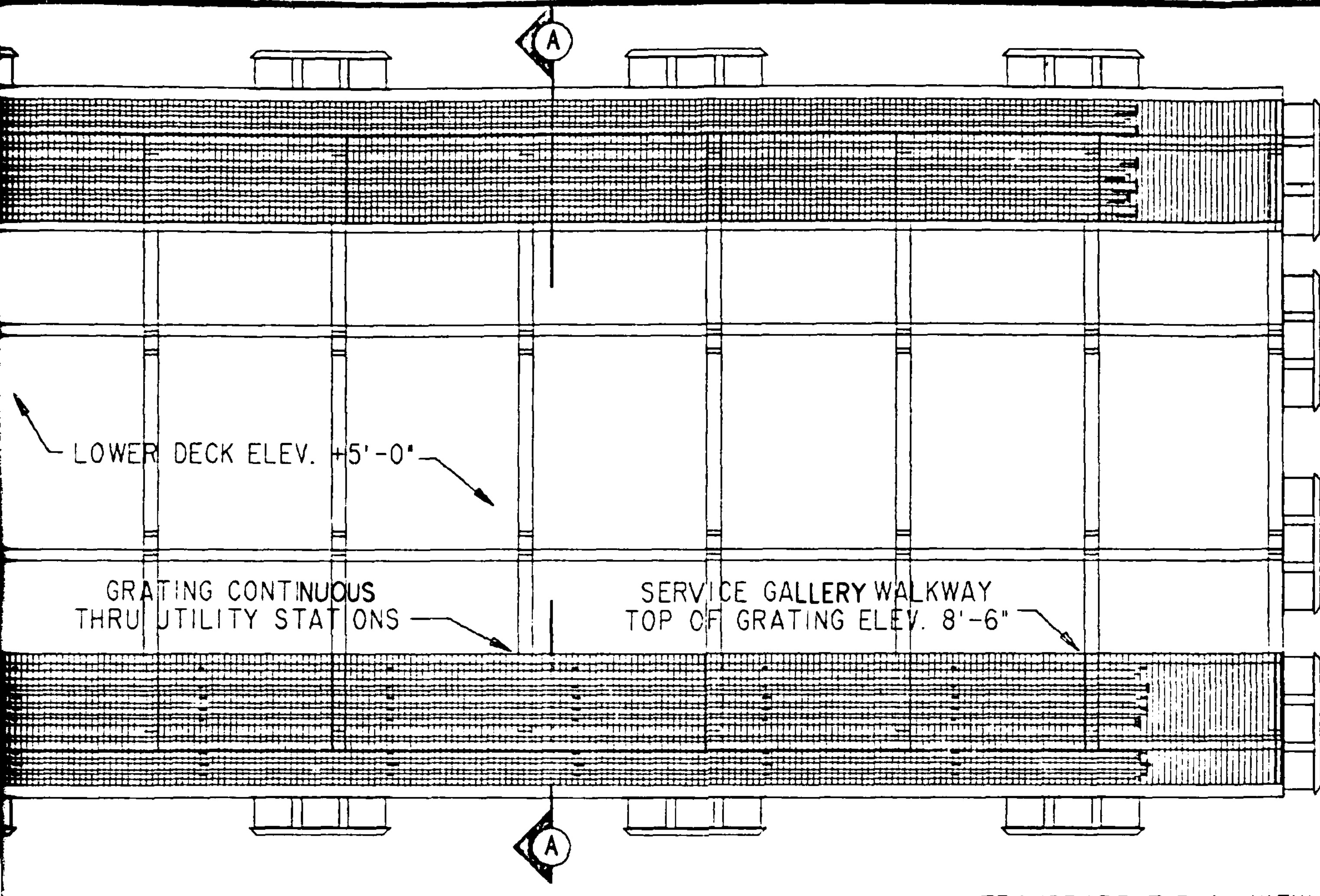

SERVICE GALLERY WALKWAY
TOP OF GRATING ELEV. 8'-6"


KWAY
8'-6"
GRATING CONTINUOUS
THRU UTILITY STATIONS
LOWER DECK ELEV. +5'-0"
0'-0"
7'-0"
9'-0'
DFM
SEWAGE
JP-5
SALT
WATER

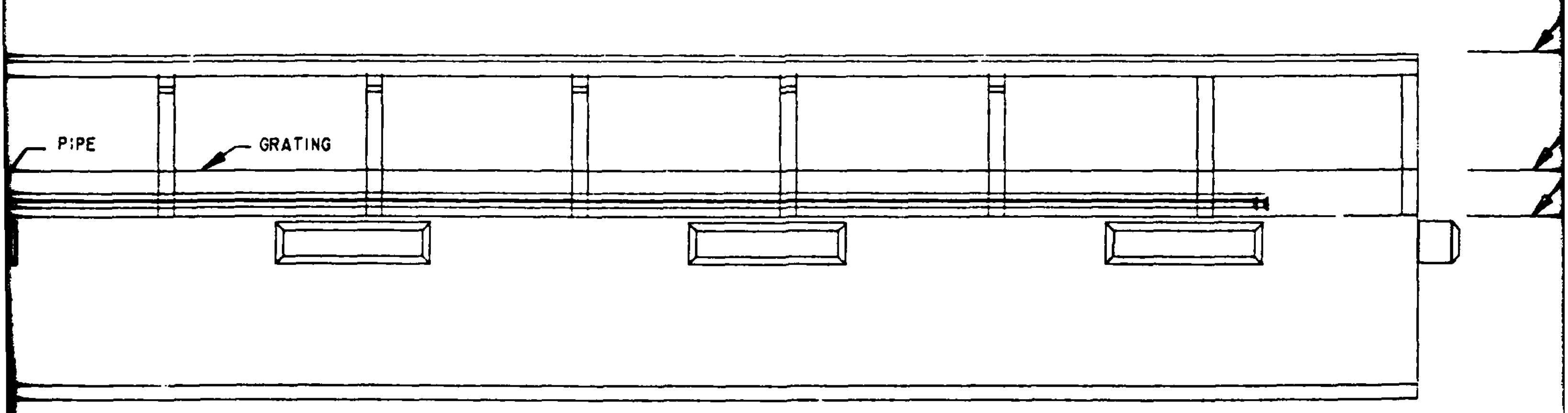


ONE WAY
VEHICULAR ACCESS
TRANSFORMER VAULT
ONE WAY
VEHICULAR ACCESS
ELEC
DIST. BOX
ELEC.
CABLE
REEL
6'-0"
5'-0"
12'-0"
7'-0"
29'-0"
4'-0"
14'-0"
29'-0"
7'-0"
12'-0"
SALT WATER
STEAM
COMPRESSED AIR
POTABLE WATER
OILY WASTE
ELECTRICAL CABLE REEL
℄ PIER
ELECTRICAL CABLE REEL
OILY WASTE
POTABLE WATER

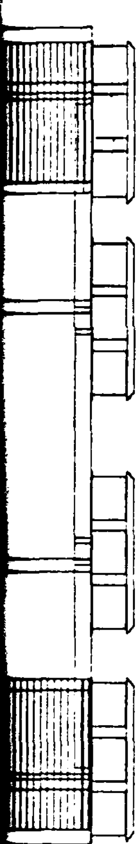

CENTER OF PIER
OPEN FOR PARKING,
STORAGE OR SERVICE AREA
LOWER DEC
GRATING
THRU UTIL
PIPEWAY BELOW GRATING
7'-0"
12'-0"
5'-0"
6'-0"
9'-0"
7'-0"
10'-0"
OILY WASTE
POTABLE WATER
COMPRESSED AIR
STEAM
SALT WATER
JP-5
SEWAGE
DFM
PIPE
PIPEWAY



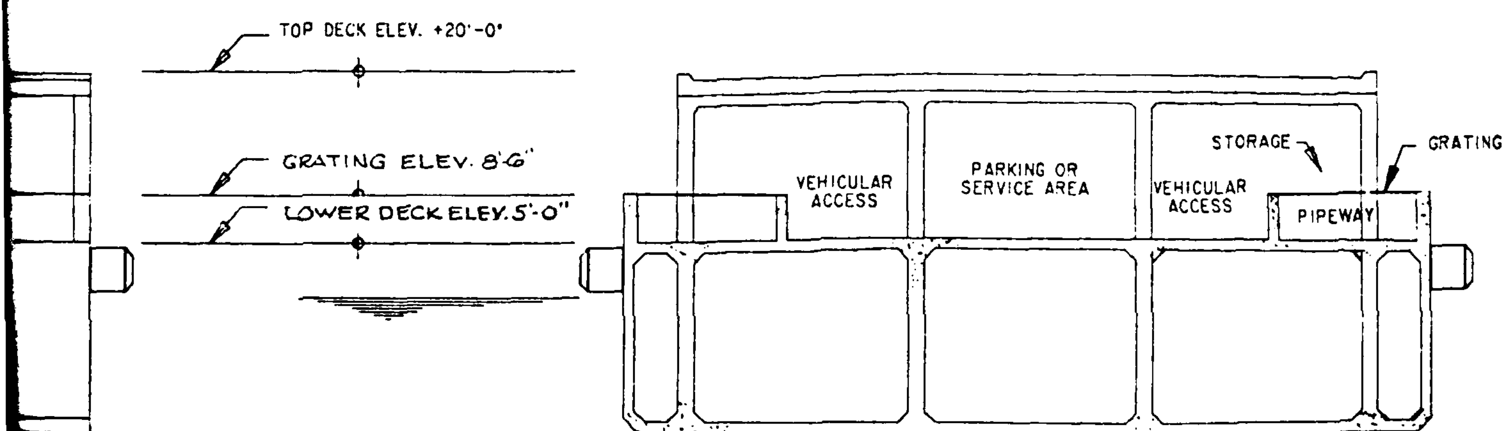
TRANSPARENT PLAN VIEW



TRANSPARENT ELEVATION

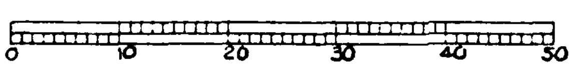


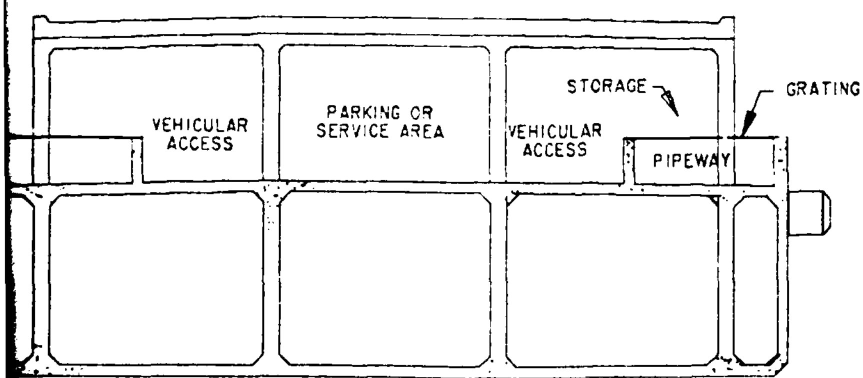
AN VIEW



VATION

END SECTION VIEW A-A





SECTION VIEW A-A

30 40 50

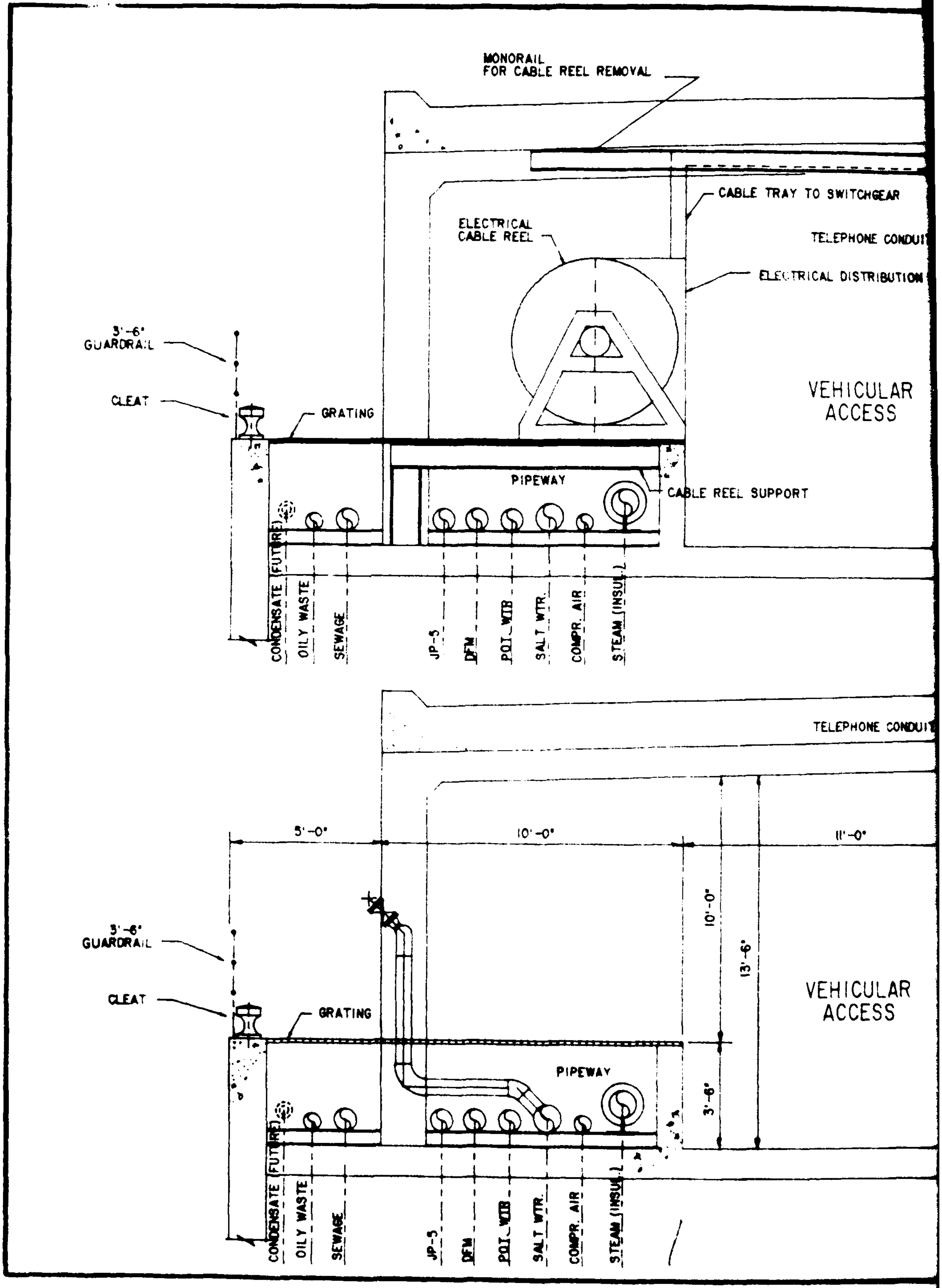
CONTRACT N 62474-82-C-8303

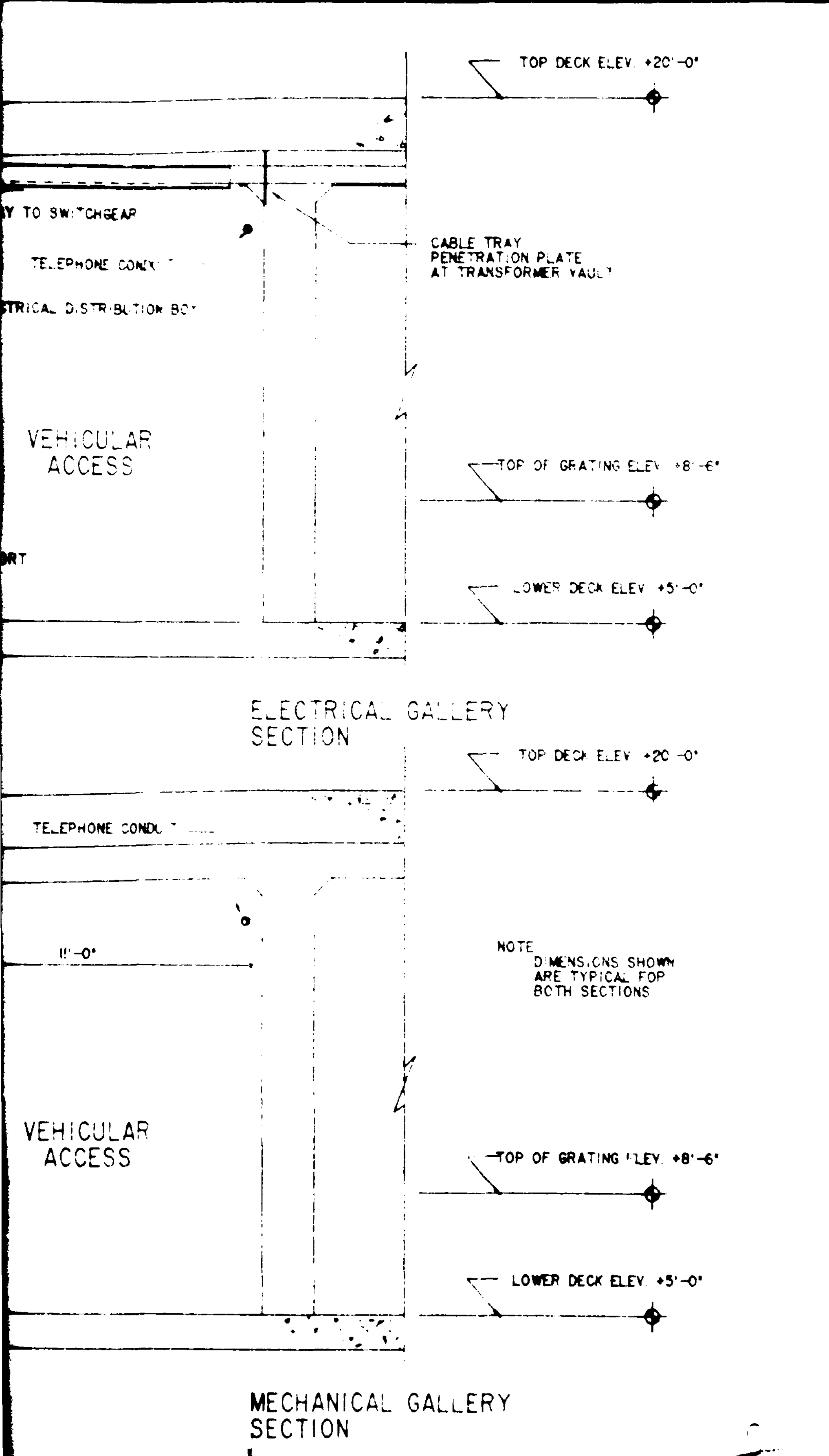
CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY

FLOATING PIER
PLAN, ELEVATION & SECTION

DRAWING NO. 11

BROWN & ROOT DEVELOPMENT, INC.


MONORAIL
FOR CABLE REEL REMOVAL
CABLE TRAY TO SWITCHGEAR
ELECTRICAL
CABLE REEL
TELEPHONE CONDUIT
ELECTRICAL DISTRIBUTION
3'-6"
GUARDRAIL
CLEAT
GRATING
VEHICULAR
ACCESS
PIPEWAY
CABLE REEL SUPPORT
CONDENSATE (FUTURE)
OILY WASTE
SEWAGE
JP-5
DFM
POT. WTR
SALT WTR.
COMPR. AIR
STEAM (INSUL.)
TELEPHONE CONDUIT
5'-0"
10'-0"
11'-0"
10'-0"
13'-6"
3'-6"
3'-6"
GUARDRAIL
CLEAT
GRATING
VEHICULAR
ACCESS
PIPEWAY
CONDENSATE (FUTURE)
OILY WASTE
SEWAGE
JP-5
DFM
POT. WTR
SALT WTR.
COMPR. AIR
STEAM (INSUL.)



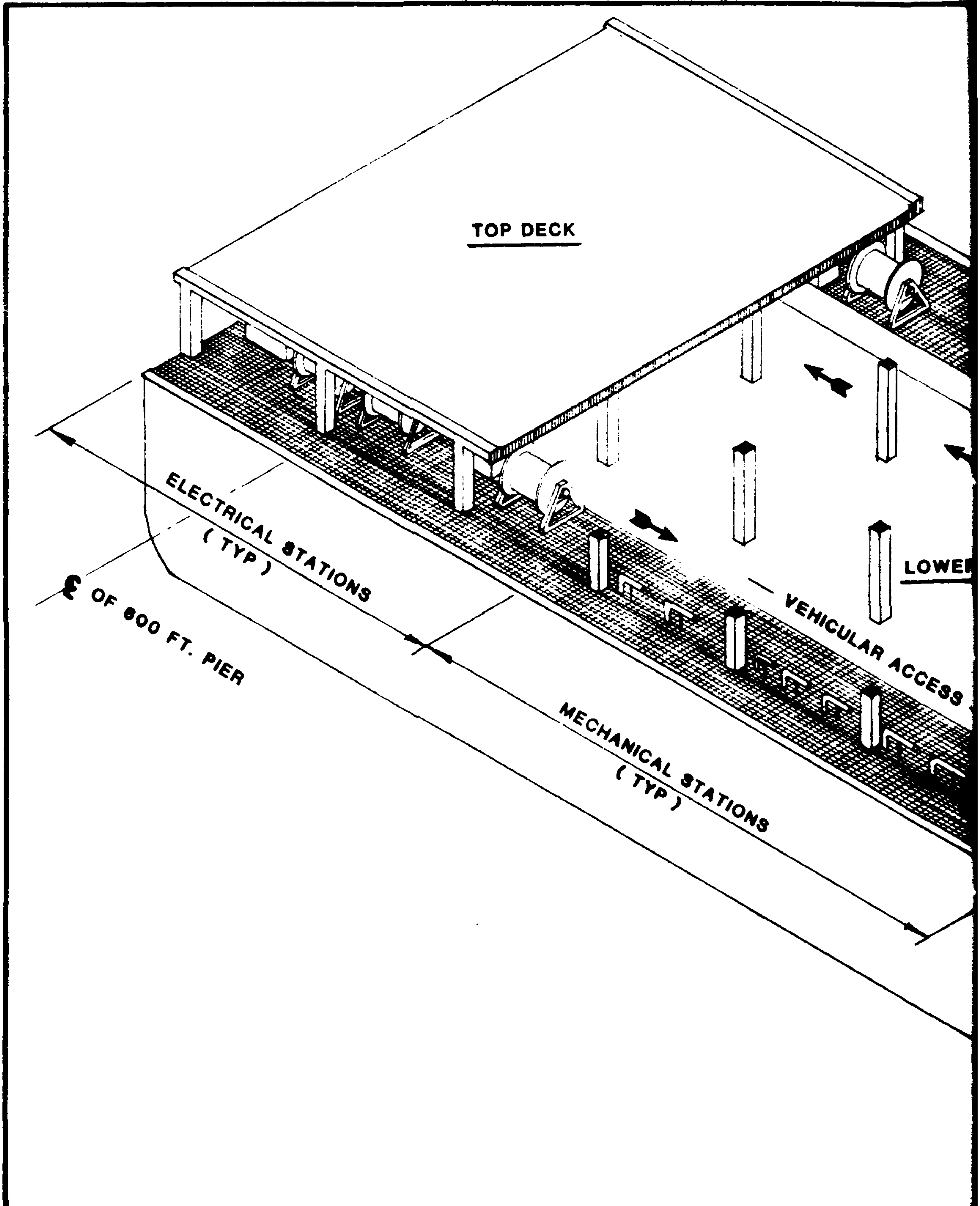
CONTRACT N 62474-82-C-8303

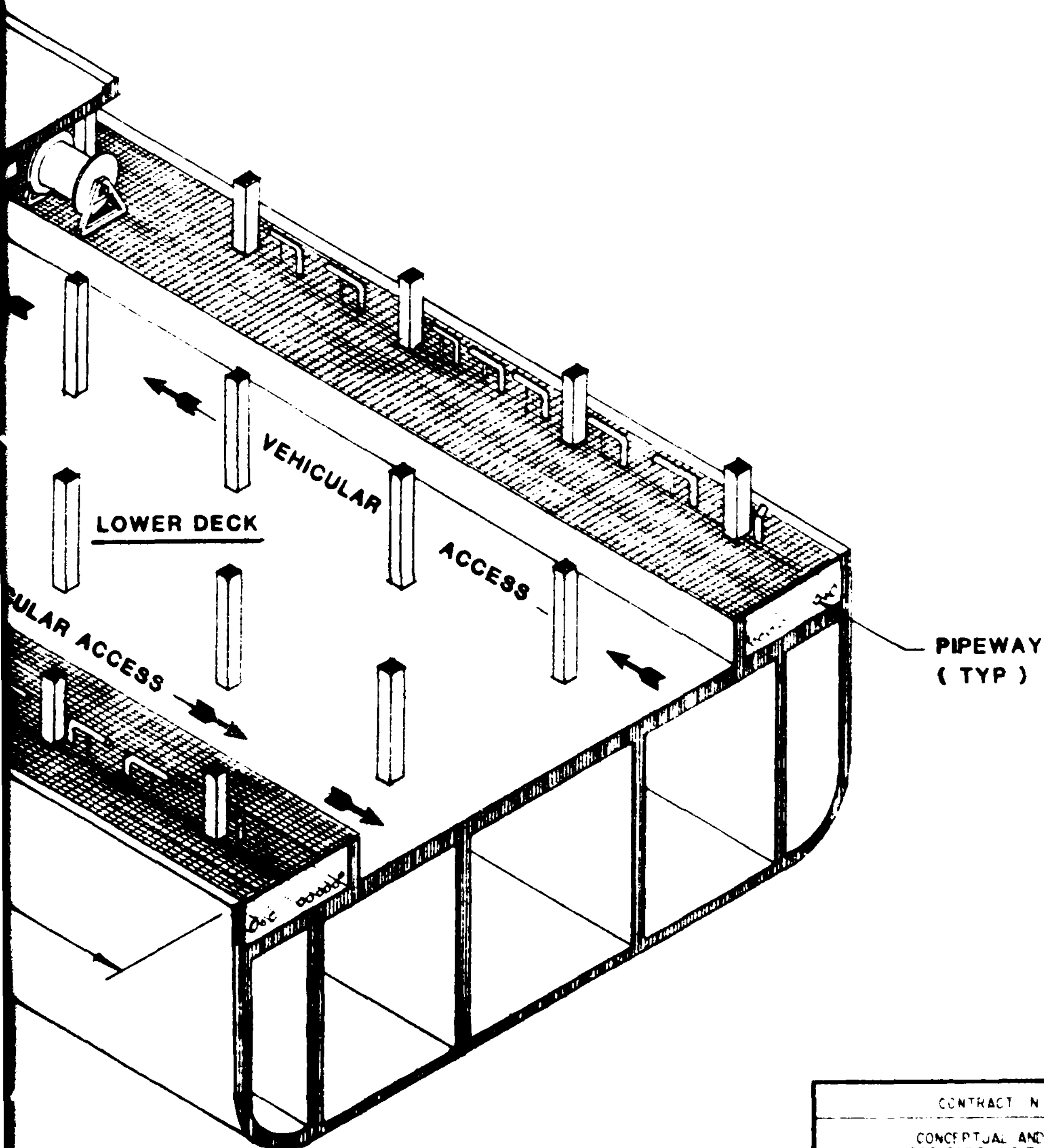
CONCEPTUAL AND DEFINITIVE DESIGNS
FOR BERTHING PIER UTILITY GALLERY

FLOATING PIER
GALLERY SECTIONS

DRAWING NO. 12

BROWN & ROOT DEVELOPMENT, INC.


TOP DECK
ELECTRICAL STATIONS
(TYP)
℄ OF 600 FT. PIER
MECHANICAL STATIONS
(TYP)
VEHICULAR ACCESS
LOWE

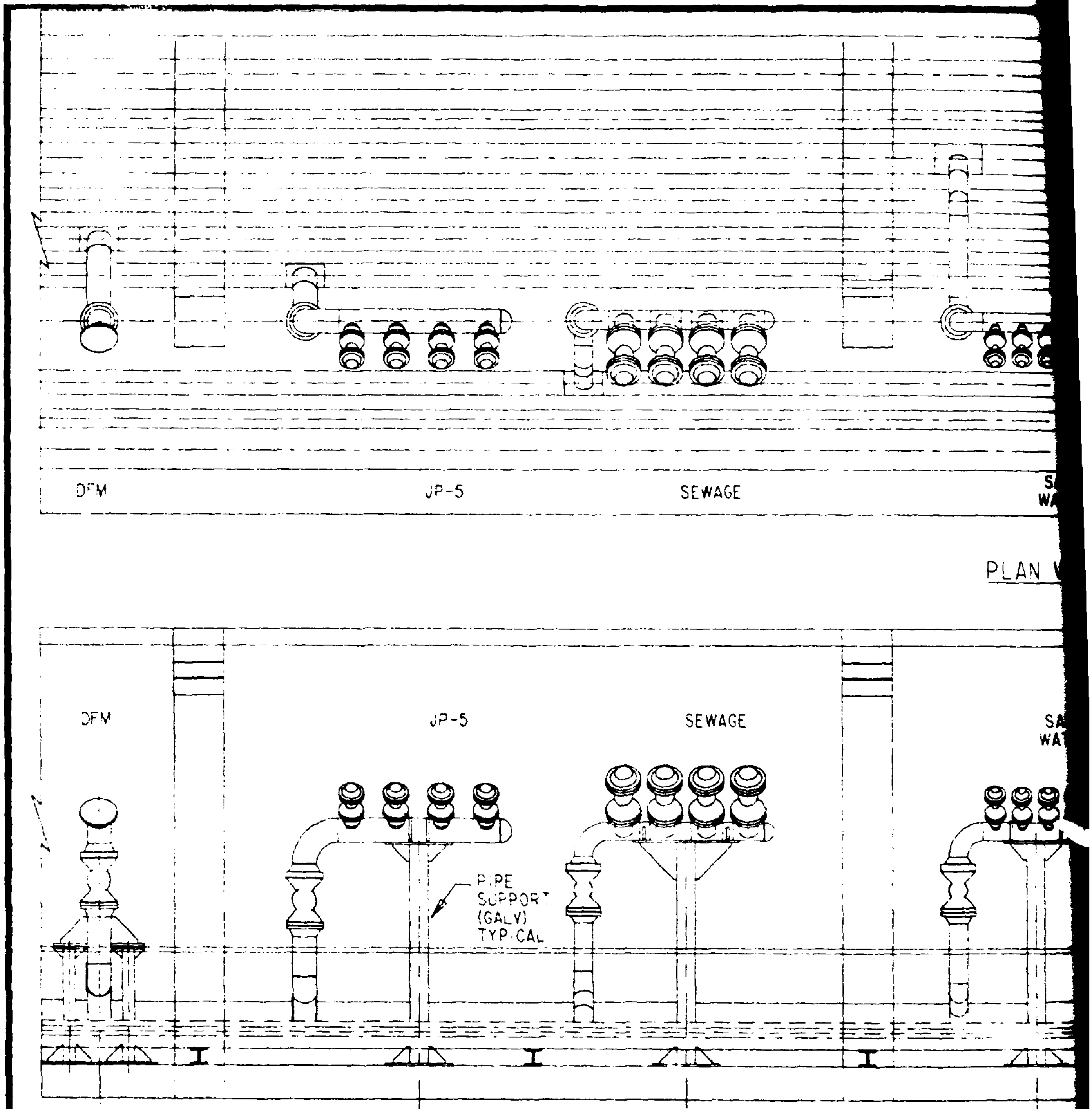


CONTRACT N62474-82-C-8303

CONCEPTUAL AND DEFINITIVE DESIGNS
FOR BERTHING PIER UTILITY GALLERY

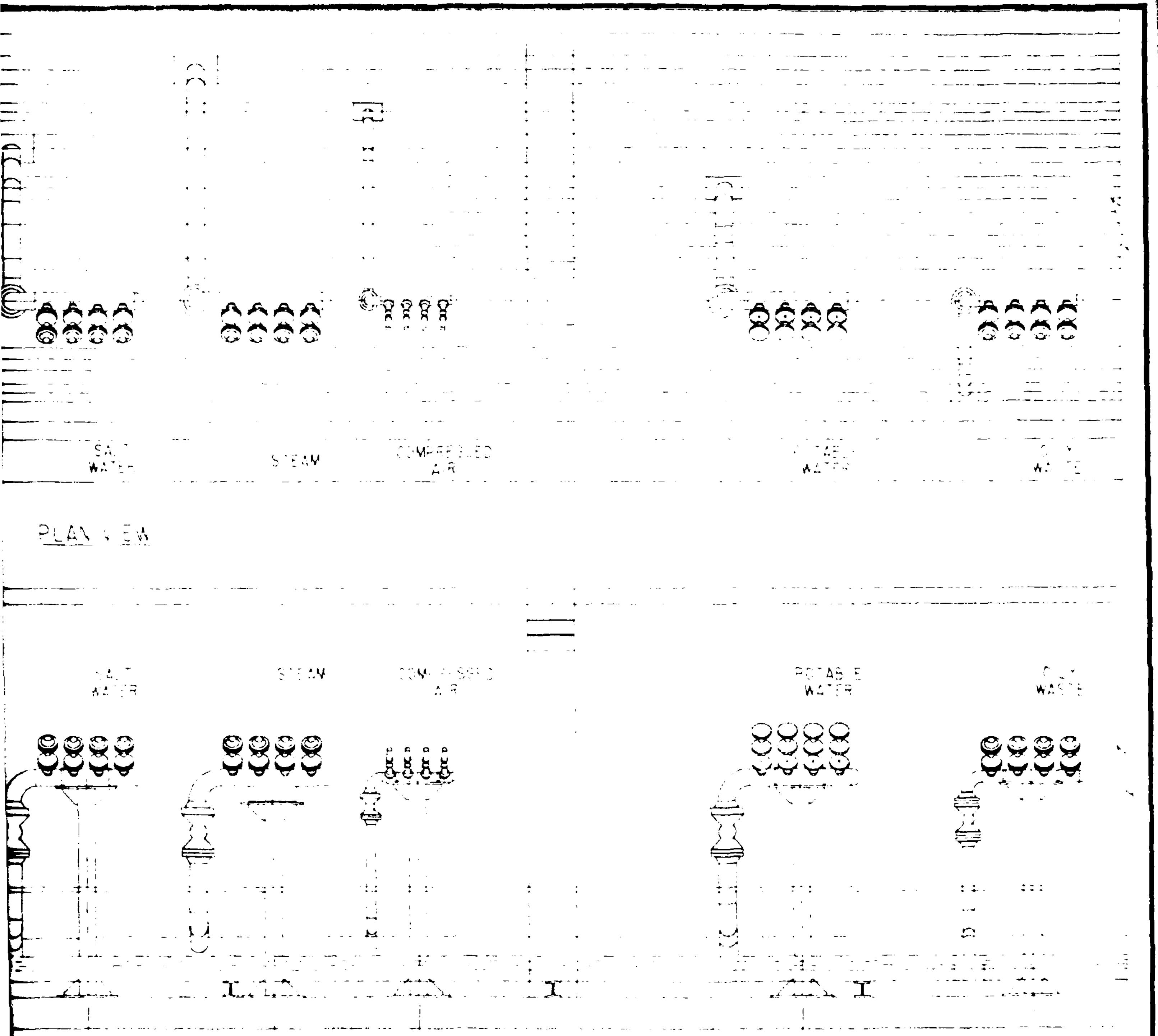
FLOATING PIER GALLERY PERSPECTIVE	DRAWING NO. **13**

BROWN & ROOT DEVELOPMENT, INC.



PLAN V

ELEVATI



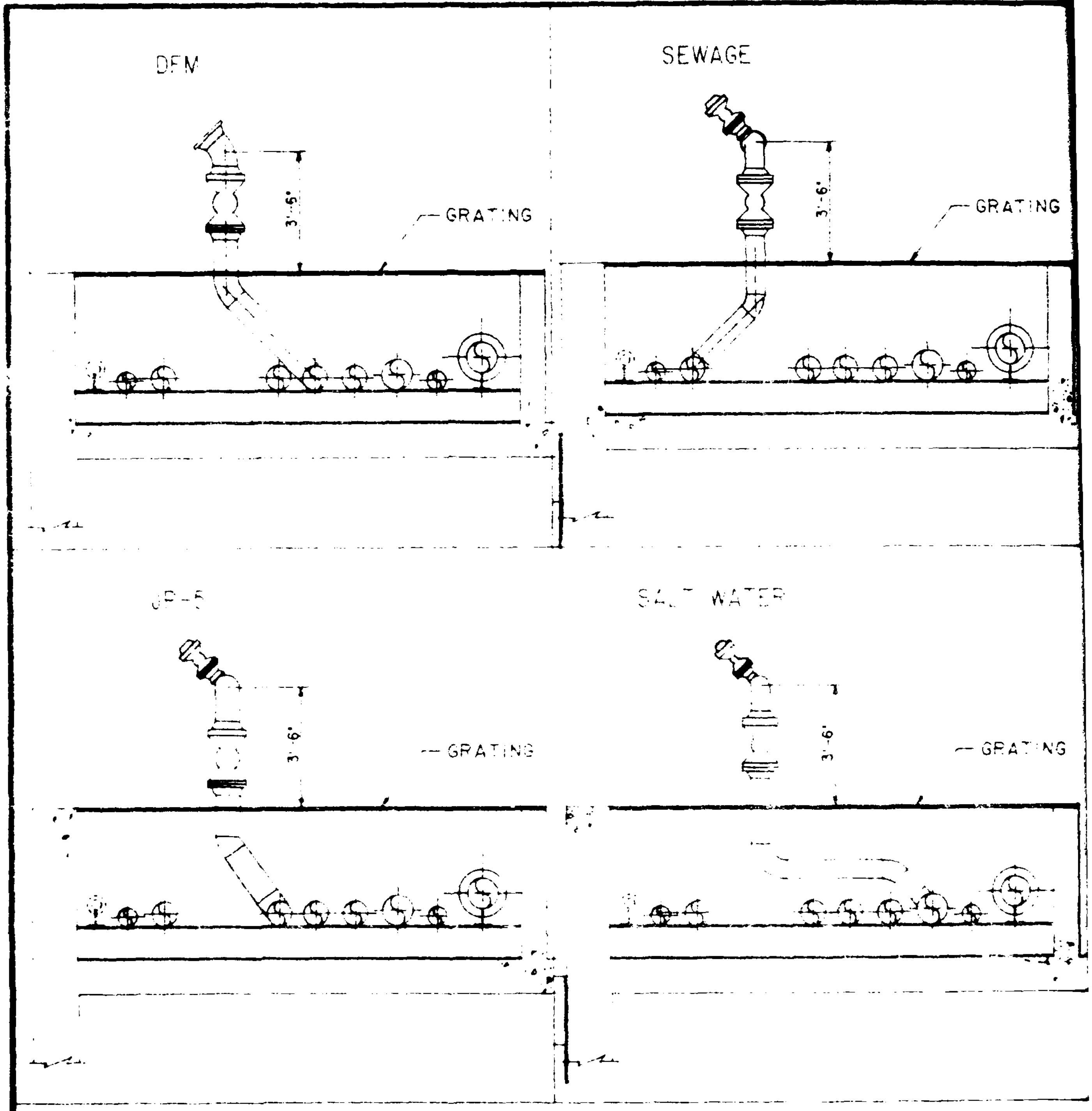
ELEVATION

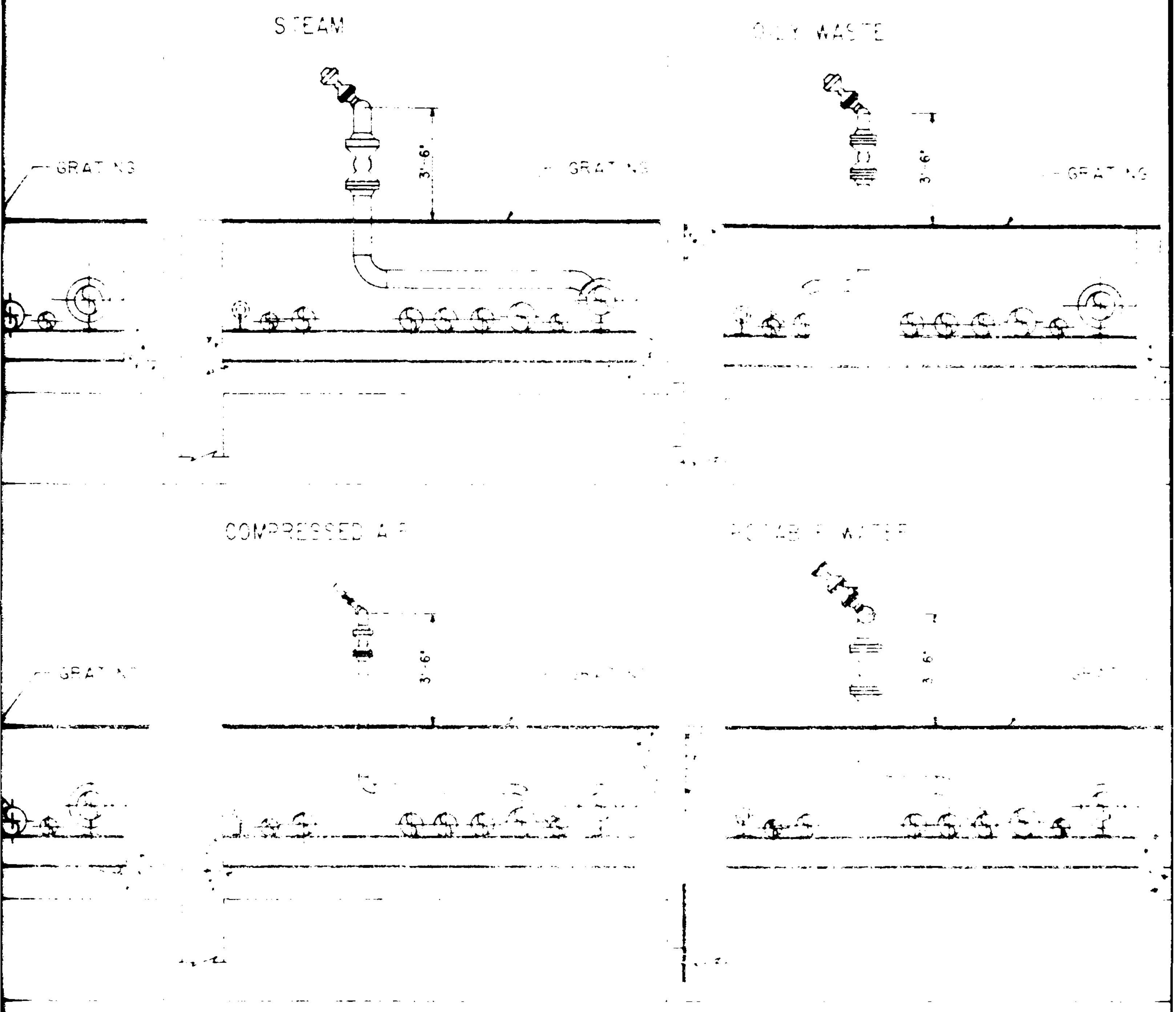
CONTRACT N 62474-82-C-8303

DRAWING NO

UTILITY STATIONS, PLAN & ELEV. 14

BROWN & ROOT DEVELOPMENT INC


DFM
3'-6"
GRATING
SEWAGE
3'-6"
GRATING
JP-5
3'-6"
GRATING
SALT WATER
3'-6"
GRATING



0 2 3 4 5 6 7 8 9 10

CONTRACT N 62474-82-C-8303

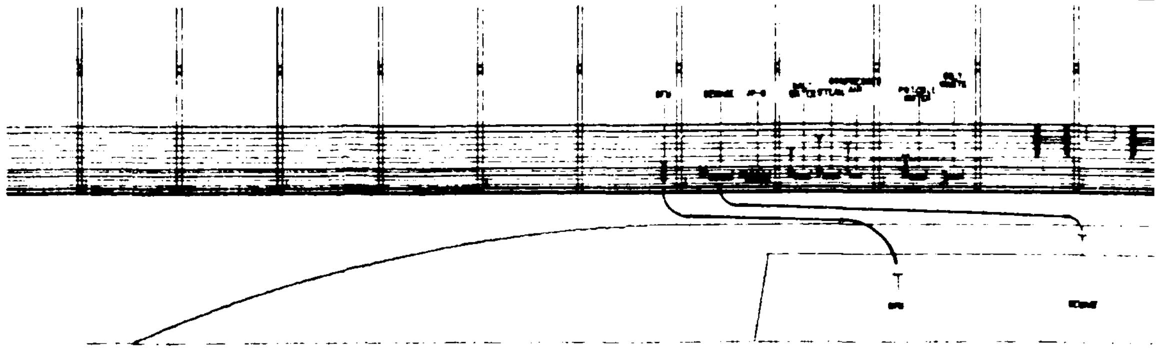
CONCEPTUAL AND DEFINITIVE DESIGNS
FOR BERTHING PIER UTILITY GALLERY

FLOATING PIER
UTILITY STATIONS, SECTIONS

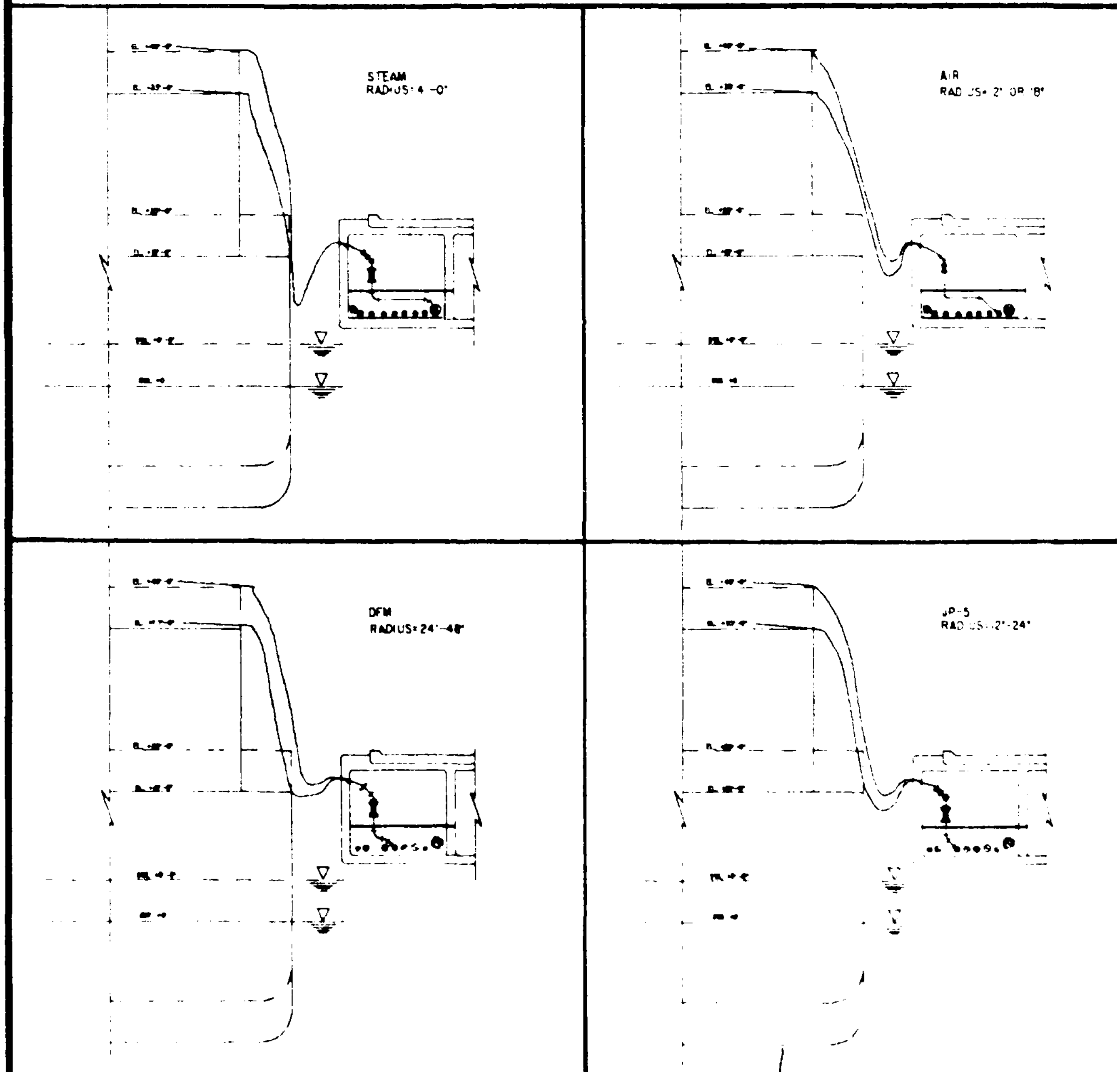
DRAWING NO
15

BROWN & ROOT DEVELOPMENT, INC.

2



FFG-7 GUIDED MIS



AD-A131 463 CONCEPTUAL DESIGNS FOR BERTHING PIER GALLERIES AND DECK LIGHTING(U) BROWN AND ROOT DEVELOPMENT INC HOUSTON TX JUN 83 NCEL-CR-83.032 N62474-82-C-8303 2/2

UNCLASSIFIED F/G 13/2 NL

END
DATE
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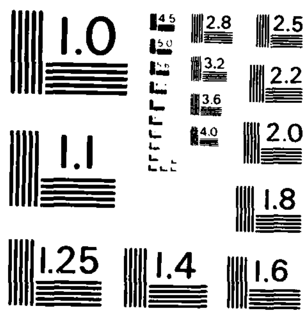
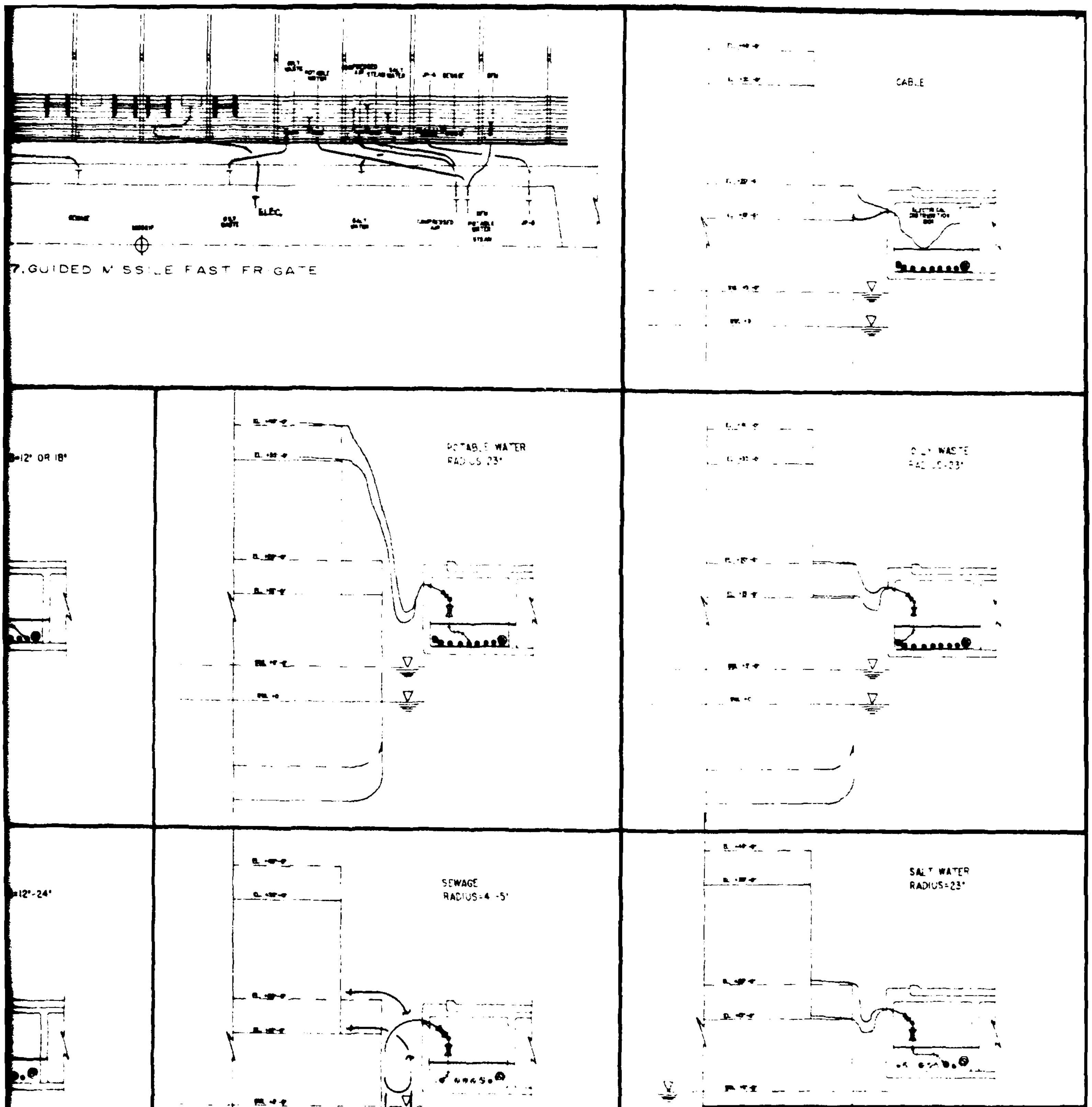


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



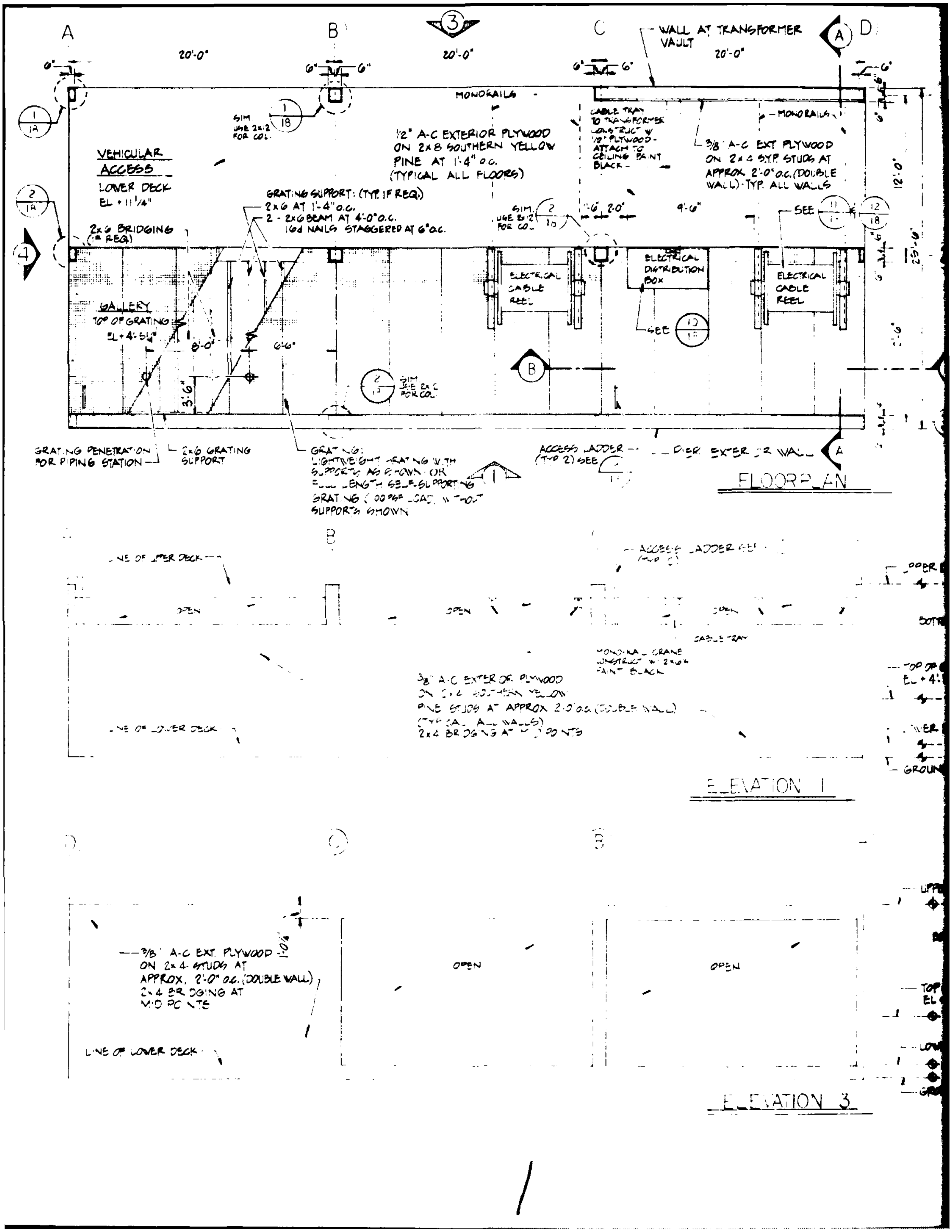
CONTRACT N 62474 62-C-6703

CONCEPTUAL AND DEFINITIVE DESIGNS
FOR BERTHING PIER UTILITY GALLERY

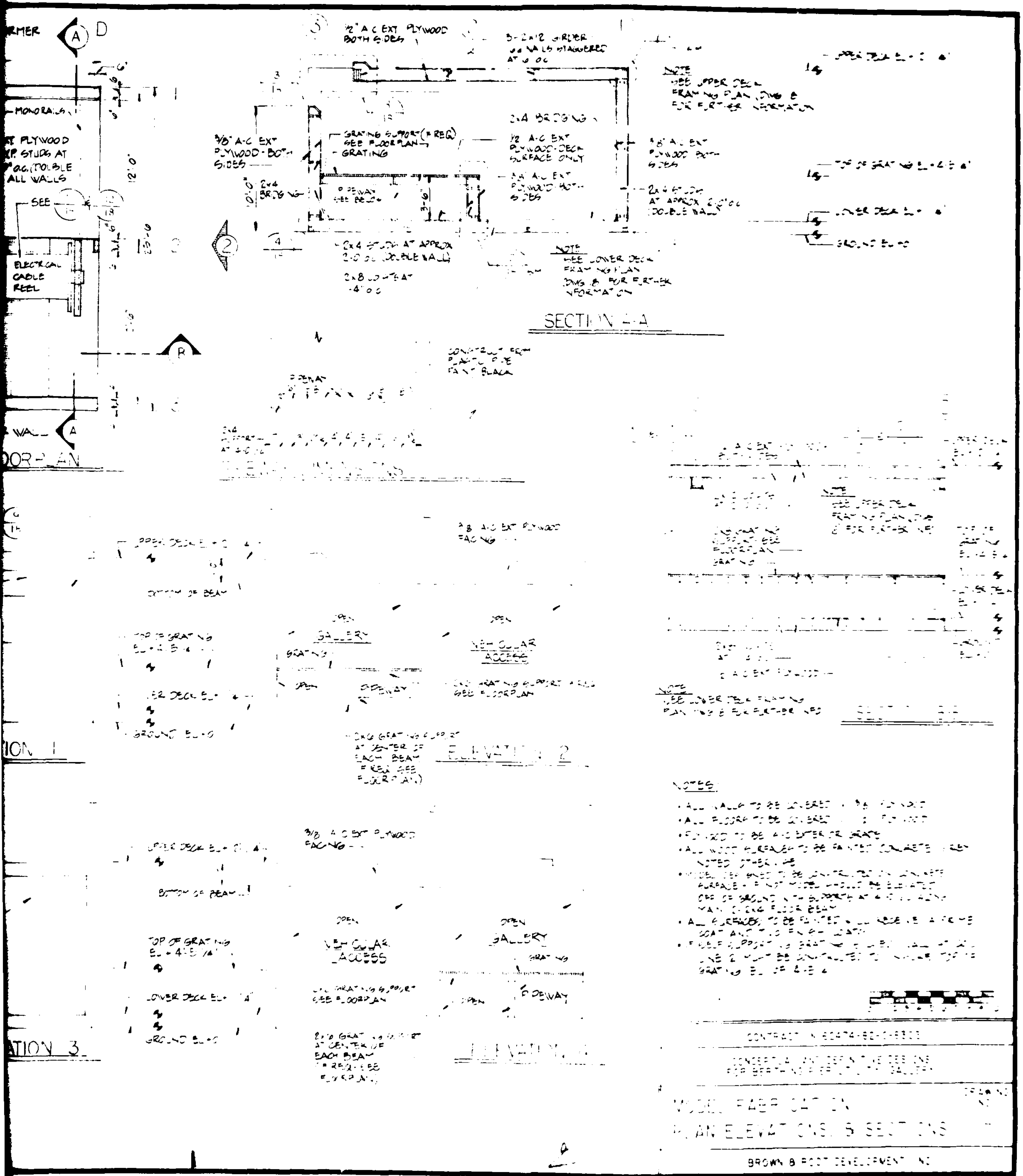
CABLE AND HOSE CONNECTIONS
PLANS & SECTIONS

DRAWING NO. 16

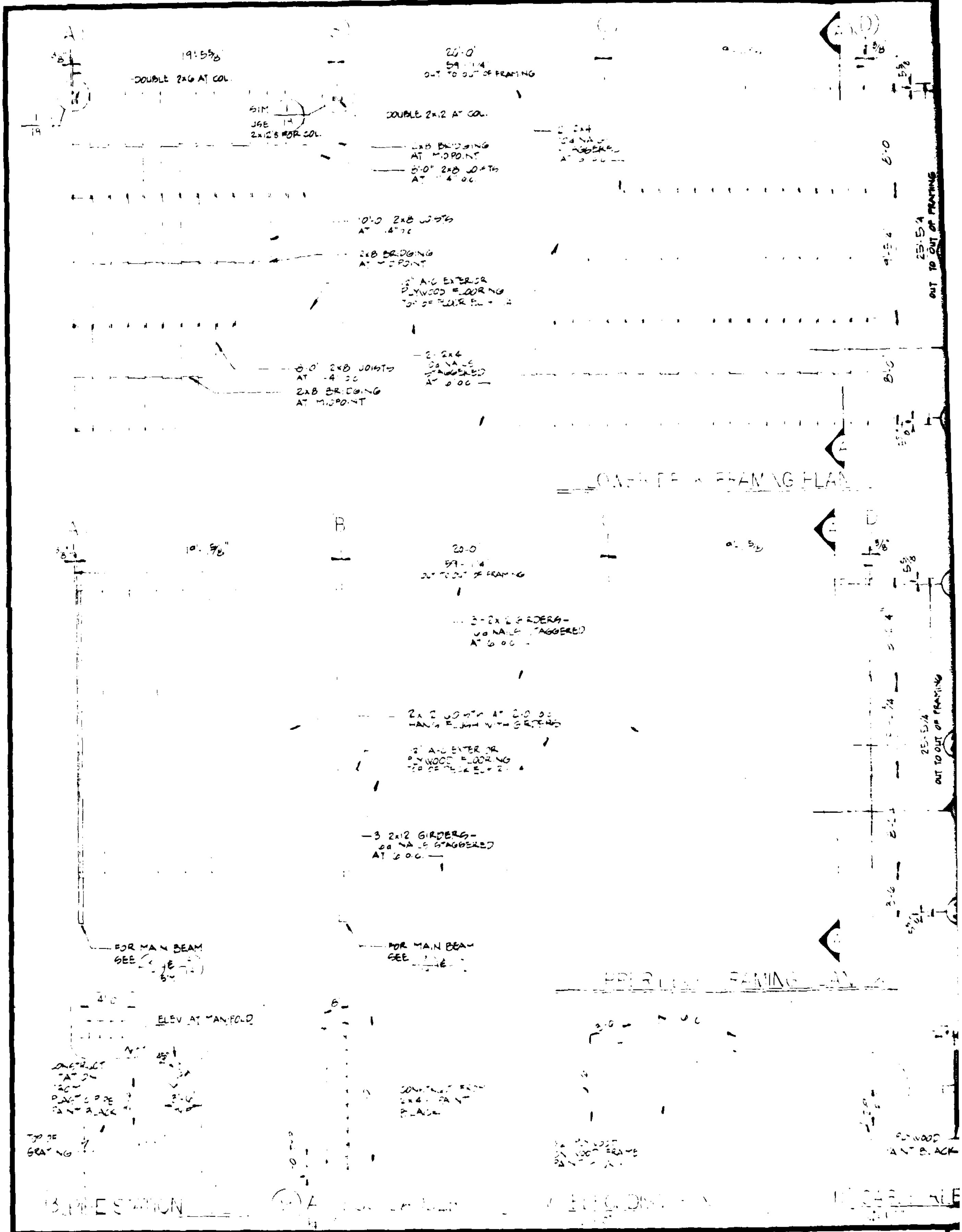
BROWN & ROOT DEVELOPMENT, INC.



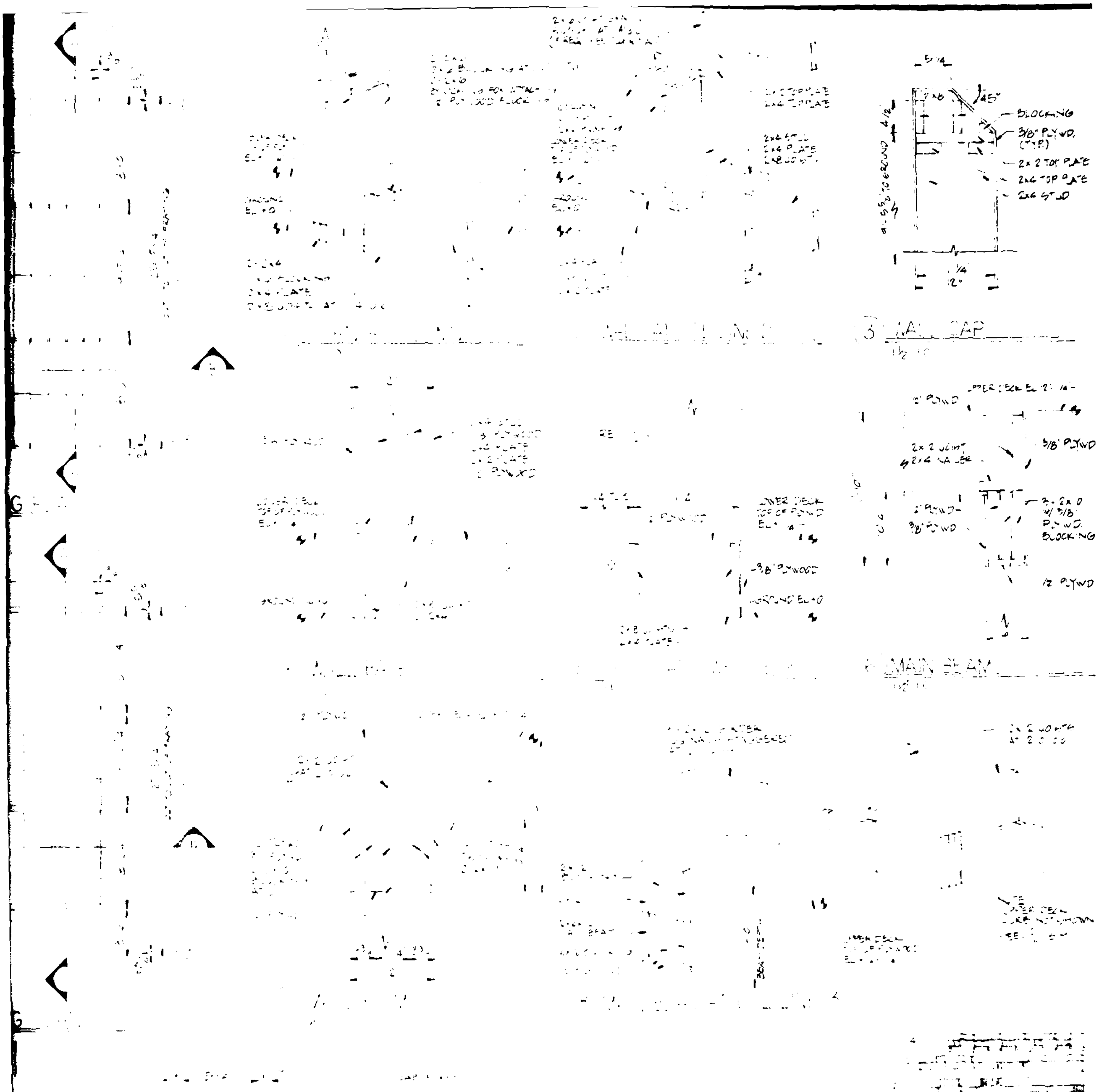
A
B
C
D
20'-0"
20'-0"
20'-0"
WALL AT TRANSFORMER VAULT
MONORAILS
SIM. USE 2x12 FOR COL.
1/2" A-C EXTERIOR PLYWOOD ON 2x8 SOUTHERN YELLOW PINE AT 1'-4" o.c. (TYPICAL ALL FLOORS)
CABLE TRAY TO TRANSFORMER CONSTRUCT W 1/2" PLYWOOD - ATTACH TO CEILING PAINT BLACK
3/8" A-C EXT PLYWOOD ON 2x4 S.Y.P. STUDS AT APPROX 2'-0" o.c. (DOUBLE WALL) - TYP. ALL WALLS
VEHICULAR ACCESS
LOWER DECK
EL + 11 1/4"
GRATING SUPPORT: (TYP. IF REQ.)
2x6 AT 1'-4" o.c.
2 - 2x6 BEAM AT 4'-0" o.c.
16d NAILS STAGGERED AT 6" o.c.
2x6 BRIDGING (IF REQ.)
SEE
12'-0"
9'-6"
ELECTRICAL CABLE REEL
ELECTRICAL DISTRIBUTION BOX
ELECTRICAL CABLE REEL
GALLERY
TOP OF GRATING
EL + 4'-5 1/4"
8'-0"
6'-6"
3'-6"
GRATING PENETRATION FOR PIPING STATION
2x6 GRATING SUPPORT
GRATING: LIGHTWEIGHT GRATING WITH SUPPORTS AS SHOWN OR FULL LENGTH SELF-SUPPORTING GRATING (100 PSF LOAD) WITHOUT SUPPORTS SHOWN
ACCESS LADDER (TYP 2) SEE
FLOOR PLAN
LINE OF UPPER DECK
OPEN
OPEN
OPEN
ACCESS LADDER
CABLE TRAY
MONORAIL CRANE CONSTRUCT W/ 2x6 PAINT BLACK
3/8" A-C EXTERIOR PLYWOOD ON 2x4 SOUTHERN YELLOW PINE STUDS AT APPROX 2'-0" o.c. (DOUBLE WALL) (TYPICAL ALL WALLS) 2x4 BRIDGING AT MID POINTS
LINE OF LOWER DECK
UPPER
GROUND
ELEVATION 1
3/8" A-C EXT. PLYWOOD ON 2x4 STUDS AT APPROX. 2'-0" o.c. (DOUBLE WALL) 2x4 BRIDGING AT MID POINTS
LINE OF LOWER DECK
OPEN
OPEN
ELEVATION 3



SECTION A-A
1/2" A-C EXT PLYWOOD BOTH SIDES
3-2x12 GIRDER
NOTE
SEE UPPER DECK FRAMING PLAN DWG 8 FOR FURTHER INFORMATION
2x4 BRIDGING
GRATING SUPPORT (# REQ) SEE FLOORPLAN
GRATING
3/8" A-C EXT PLYWOOD-BOTH SIDES
1/2 A-C EXT PLYWOOD-DECK SURFACE ONLY
2x4 BRIDGING
2x4 STUDS AT APPROX 2'-0" OC DOUBLE WALL
2x8 JOISTS AT 4' OC
NOTE
SEE LOWER DECK FRAMING PLAN DWG 8 FOR FURTHER INFORMATION
MONORAILS
ELECTRICAL CABLE REEL
DOOR PLAN
CONSTRUCT FROM PLASTIC PIPE PAINT BLACK
BOTTOM OF BEAM
TOP OF GRATING
GROUND EL.
GALLERY
GRATING
OPEN
OPENWAY
VEHICULAR ACCESS
ELEVATION 2
ELEVATION 3
3/8 A-C EXT PLYWOOD FACING
TOP OF GRATING EL.+4'-6 1/4"
LOWER DECK EL.
NOTES
CONTRACT N62474-82-C-8303
MODEL FABRICATION
PLAN ELEVATIONS & SECTIONS
BROWN & ROOT DEVELOPMENT INC



DOUBLE 2x6 AT COL.
DOUBLE 2x12 AT COL.
2x12'S FOR COL.
2x8 BRIDGING AT MIDPOINT
8'-0" 2x8 JOISTS
10'-0 2x8 JOISTS
2x8 BRIDGING
A-C EXTERIOR PLYWOOD FLOORING
2-2x4
STAGGERED
2x8 BRIDGING AT MIDPOINT
20-0
OUT TO OUT OF FRAMING
3-2x12 GIRDERS-
NAILS STAGGERED
3 2x12 GIRDERS-
NAILS STAGGERED
FOR MAIN BEAM SEE
ELEV AT MANIFOLD
PLASTIC PIPE
PAINT BLACK
TYP OF GRATING
PLYWOOD
PAINT BLACK
25'-5 1/4 OUT TO OUT OF FRAMING



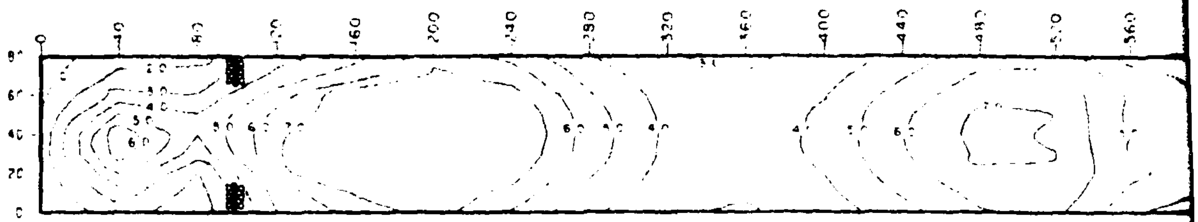
CONTRACT N 62474-82-C-8303

CONCEPTUAL AND DEFINITIVE DESIGNS FOR BERTHING PIER UTILITY GALLERY

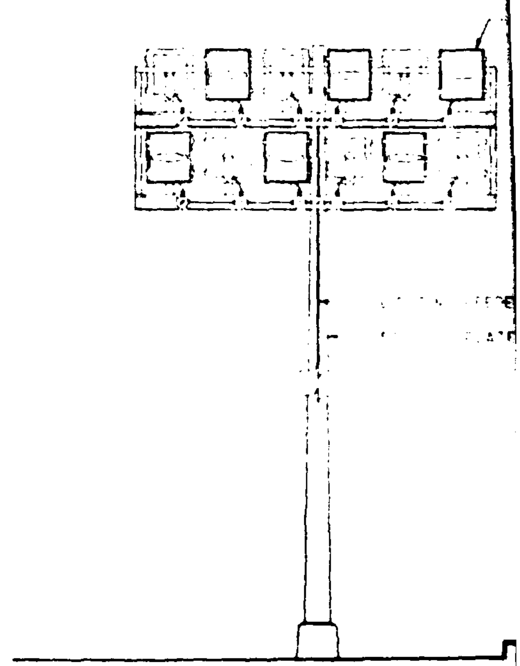
MODEL FABRICATION DETAILS

DRAWING NO 18

BROWN & ROOT DEVELOPMENT, INC



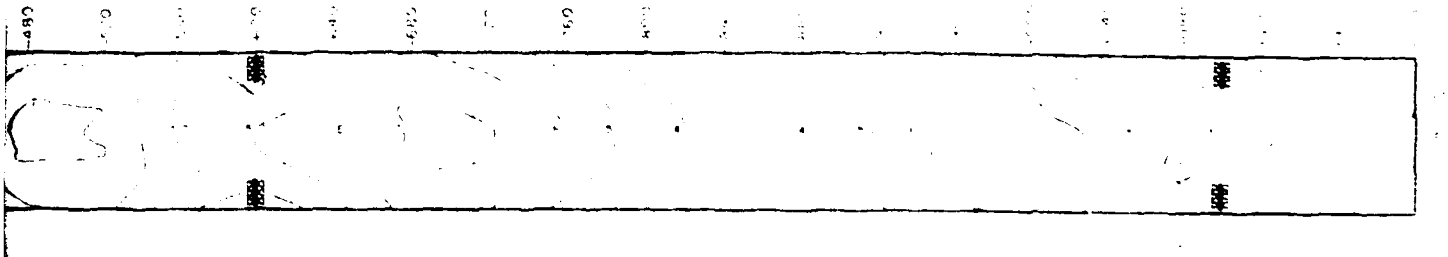
PLA



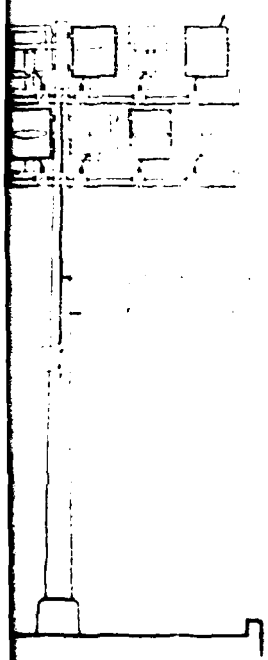
SECTION 'A-A'

TYPICAL FLOODLIGHT MOUNTING DETAIL

NOT TO SCALE

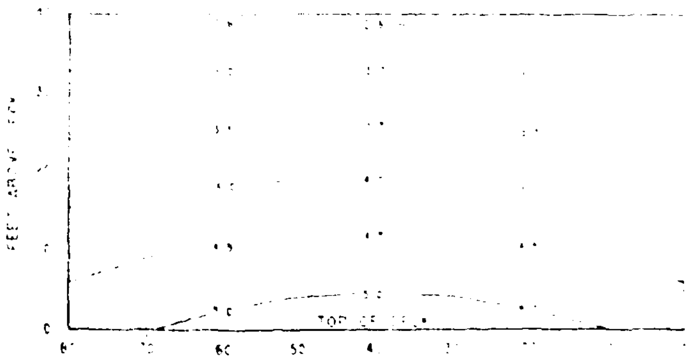


PLAN VIEW



TION "A-A"

TO SCALE



SECTION "B-B"

19

APPENDIX A

TABLES

- TABLE A-1 - SHIP SERVICE POINT LOCATIONS
- TABLE A-2 - TIDE PLANES (APPROXIMATED) IN FEET AT SELECTED NAVAL STATIONS
- TABLE A-3 - LINE SPACING (UNINSULATED) - CLASS 125 AND 150 LB FLANGES
- TABLE A-4 - LINE SPACING (UNINSULATED) - CLASS 250 AND 300 LB FLANGES

		ELECTRICAL					STEAM					POTABL[E]		
	SHIP CLASS	AD-41	FF-1052	DD-963	CG-47	FFG-7	AD-41	FF-1052	DD-963	CG-47	FFG-7	AD-41	FF-1052	DD-[illegible]
PORT SIDE	DECK NUMBER	3 3	02	03	01	02	4 4	1	01	01	02	3 4 4	1	[illegible]
PORT SIDE	FRAME NUMBER	100 126	84	237	280	219	49 106	103	306	299	283	24 131 75	103	[illegible]
PORT SIDE	DISTANCE FROM MIDSHIP (FEET) [1]	-95 -199	-8	-12	29	-30	109 -119	-56	-57	-49	-94	209 -219 5	-35	[illegible]
PORT SIDE	HEIGHT (FEET)	26 26	30	47	25	35	15 15	16	26	25	35	28 15 15	16	[illegible]
STARBOARD SIDE	DECK NUMBER	3 3	02	03	01	02	4 4	1	01	01	02	3 4 4	1	[illegible]
STARBOARD SIDE	FRAME NUMBER	100 131	84	237	280	219	49 106	103	260	292	285	24 130 77	103	[illegible]
STARBOARD SIDE	DISTANCE FROM MIDSHIP (FEET) [1]	-95 -219	-8	-12	29	-30	109 -119	-56	-11	-41	-96	209 -215 -3	-35	[illegible]
STARBOARD SIDE	HEIGHT (FEET)	26 26	30	47	25	35	15 15	16	26	25	35	28 15 15	16	[illegible]
	MEAN DESIGN LOCATION (FEET) [2]	N/A	25				N/A	62				N/A		
	MAXIMUM SERVICE OFFSET (FEET) [3]	N/A	13				N/A	51				N/A		

NOTES

[1] THE MIDSHIP POINT IS TAKEN AS ONE-HALF OF THE SHIP'S TOTAL LENGTH ALONG THE MAIN DECK. THE DISTANCE FORWARD OF MIDSHIPS IS SHOWN POSITIVE (NO SIGN). THE DISTANCE AFT OF MIDSHIPS IS SHOWN NEGATIVE (- SIGN).

[2] THE MEAN DESIGN LOCATION WAS CALCULATED FOR BOTH STARBOARD AND PORT SIDE BERTHING CONDITIONS FOR ALL DESIGN SHIPS EXCEPT THE AD-41.

[3] THE MAXIMUM SERVICE OFFSET IS THE MAXIMUM DISTANCE OF ANY SERVICE POINT OF THE DESIGN SHIPS FROM THE MEAN DESIGN LOCATION (EXCLUDING THE AD-41).

POTABLE WATER				
AD-41	FF-1052	DD-963	CG-47	FFG-7
3 4 4	1	01	01	02
24 131 75	103	300	243	285
209 -219 5	-35	51	8	-26
28 15 15	16	26	25	35
3 4 4	1	01	01	02
24 130 77	103	240	243	285
209 -215 -3	-35	9	8	-96
28 15 15	16	26	25	35
N/A	52			
N/A	44			

SALTWATER				
AD-41	FF-1052	DD-963	CG-47	FFG-7
3 4	1	-	01 01	1
24 106	103	-	333 371	254
209 -119	-56	-	-84 -120	-65
28 15	16	-	25 25	15
3 4	1	-	01 01	1
24 106	103	-	274 341	254
209 -119	-56	-	-23 -90	-65
28 15	16	-	25 25	15
N/A	72			
N/A	49			

SEWAGE				
AD-41	FF-1052	DD-963	CG-47	FFG-7
3	1 1	-	01 01	1
148	45 124	-	190 380	173
-287	90 -108	-	61 -129	16
26	16 16	-	25 25	17
3	01 1	01	01 01	1
148	45 124	197	190 380	170
-287	90 -108	52	61 -129	19
26	21 16	26	25 25	17
N/A	73			
N/A	56			

OILY WASTE				
AD-41	FF-1052	DD-963	CG-47	FFG-
3	1	01	-	1
148	103	191	-	215
-287	-55	72	-	-26
26	16	26	-	16
3	1	01	-	1
148	105	184	-	215
-287	-60	65	-	-26
26	16	26	-	16
N/A	41			
N/A	23			

OILY WASTE				COMPRESSED AIR					FUEL JP-5					FUEL DFM				
FF-1052	DD-963	CG-47	FFG-7	AD-41	FF-1052	DD-963	CG-47	FFG-7	AD-41	FF-1052	DD-963	CG-47	FFG-7	AD-41	FF-1052	DD-963	CG-47	FFG-7
1	01	-	1	3 4 4	-	01	-	02	01	01	-	01 01	02	01 01	01 01	01 01	01 01	02 02
103	191	-	215	24 75 131	-	286	-	282	126	116	-	191 377	303	59 131	55 116	191 398	191 377	133 284
-55	72	-	-26	209 5 -219	-	-37	-	-93	-199	-52	-	60 -126	-114	70 -219	65 -70	65 -149	60 -126	56 -95
16	26	-	16	28 15 15	-	26	-	35	58	26	-	25 25	35	54 58	31 26	26 26	25 25	35 35
1	01	-	1	3 4 4	01	01	-	02	01	01	-	01 01	02	01 01	01 01	01 01	01 01	02 02
105	184	-	215	24 77 130	91	286	-	282	126	109	-	191 377	303	59 131	55 109	184 398	191 377	133 284
-60	65	-	-26	209 -3 -215	-26	-37	-	-93	-199	-70	-	60 -126	-114	70 -219	65 -70	65 -149	60 -126	56 -95
16	26	-	16	28 15 15	25	26	-	35	58	26	-	25 25	35	54 58	31 26	26 26	25 25	35 35
41				N/A	65				N/A	90				N/A	101			
23				N/A	14				N/A	37				N/A	49			

SHIP SERVICE POINT LOCATIONS

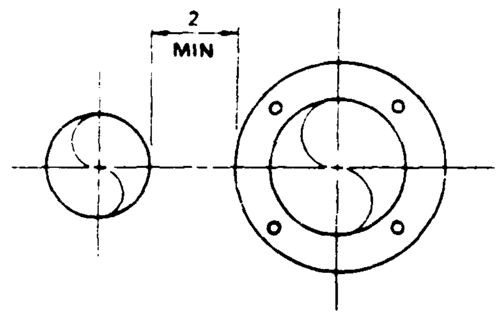
TABLE A-1

TABLE A-2

TIDE PLANES (APPROXIMATED) IN FEET
AT SELECTED NAVAL STATIONS

	EXTREME HIGH WATER	MEAN HIGHER HIGH WATER	HIGH WATER SPRINGS	MEAN HIGH WATER	MEAN TIDE LEVEL	MEAN LOW WATER	LOW WATER SPRINGS	MEAN LOWER LOW WATER	EXTREME LOW WATER
EAST COAST-U.S. DATUM-M.L.W.									
NEWPORT, RI	13.8		4.0	3.5	1.8	Ø	-0.4		-2.6
NEW LONDON, CT	11.1		2.9	2.6	1.3	Ø	-0.3		-3.0
NEWPORT NEWS, VA	10.0		2.9	2.6	1.3	Ø	-0.3		-3.5
NORFOLK, VA	9.5 (10.0)		3.1	2.8	1.4	Ø	-0.3		-3.5
LITTLE CREEK, VA	9.0		2.9	2.6	1.3	Ø	-0.3		-3.0
CHARLESTON, SC	10.7		5.8	5.1	2.6	Ø	-0.6		-2.7
JACKSONVILLE, FL	4.9		2.2	2.0	1.0	Ø	-0.2		-2.5
MAYPORT, FL	7.6		5.0	4.5	2.3	Ø	-0.4		-3.0
WEST COAST-U.S. DATUM-M.L.L.W.									
BREMERTON, WA (PORT ORCHARD)	14.7	11.7		10.8	6.8	2.8		Ø	-4.5
TACOMA, WA (COMMENCEMENT BAY)	15.5	11.8		10.9	6.8	2.8		Ø	-4.5
SAN FRANCISCO/ ALAMEDA, CA	8.8	6.4		5.8	3.5	1.1		Ø	-2.5
LONG BEACH, CA	7.5	5.3		4.6	2.7	0.9		Ø	-2.5
SEAL BEACH, CA	7.5	5.4		4.7	2.8	0.9		Ø	-2.5
SAN DIEGO, CA	8.1	5.8		5.1	3.0	0.9		Ø	-2.6

LINE SIZE	36	30	24	20	18	16	14	12	10	8	6	4	3	2	1-1/2	1
1	26	22	19	16	15	14	13	12	11	9	8	7	6	6	6	6
1-1/2	26	22	19	17	15	15	13	12	11	10	8	7	7	6	6	
2	26	23	19	17	16	15	14	13	11	10	9	8	7	6		
3	27	23	20	18	16	16	14	13	12	11	9	8	8			
4	27	24	20	18	17	16	15	14	12	11	10	9				
6	28	25	21	19	18	17	16	15	13	12	11					
8	29	26	22	20	19	18	17	16	14	13						
10	30	27	23	21	20	19	18	17	15							
12	31	28	24	22	21	20	19	18								
14	32	28	25	23	22	21	20									
16	33	29	26	24	23	22										
18	34	30	27	25	24											
20	35	31	28	26												
24	37	33	30													
30	40	36														
36	43															



CLASS 125 AND 150 LB. FLANGES

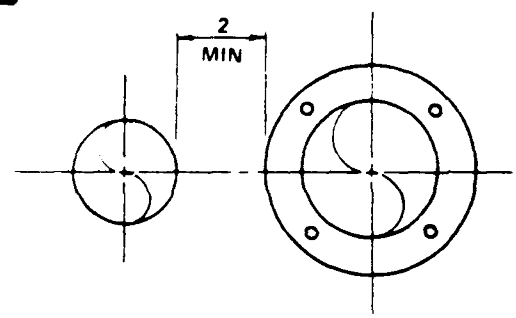
NOTES:

1. SIZES AND DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
2. MAINTAIN 2'-0" MINIMUM LONGITUDINAL SPACE BETWEEN FLANGES IN ADJACENT LINES.
3. ADD INSULATION THICKNESSES FOR INSULATED LINES AND FLANGES.
4. SPACING FOR 30" AND 36" FLANGES BASED ON 125 LB C.I. ANSI B16.1, ADJUST SPACING FOR OTHERS.

125 AND 150 LB. FLANGES - LINE SPACING (UNINSULATED)

Table: A-3

LINE SIZE	36	30	24	20	18	16	14	12	10	8	6	4	3	2	1-1/2	1
1	28	24	21	18	17	15	14	13	11	10	9	8	7	6	6	6
1-1/2	28	24	21	18	17	16	14	13	12	10	9	8	7	6	6	
2	28	25	21	19	17	16	15	13	12	11	9	8	7	6		
3	29	25	22	19	18	17	15	14	13	11	10	9	8			
4	29	26	22	20	18	17	16	15	13	12	11	9				
6	30	27	23	21	19	18	17	16	14	13	12					
8	31	28	24	22	20	19	18	17	15	14						
10	32	29	25	23	21	20	19	18	16							
12	33	30	26	24	22	21	20	19								
14	34	30	27	24	23	22	21									
16	35	31	28	25	24	23										
18	36	32	29	26	25											
20	37	33	30	27												
24	39	35	32													
30	42	38														
36	45															



CLASS 250 AND 300 LB. FLANGES

NOTES

1. SIZES AND DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
2. MAINTAIN 2'-0 MINIMUM LONGITUDINAL SPACE BETWEEN FLANGES IN ADJACENT LINES
3. ADD INSULATION THICKNESSES FOR INSULATED LINES AND FLANGES.
4. SPACING FOR 30" AND 36" FLANGES BASED ON MSS SP44 ADJUST SPACING FOR OTHERS

250 AND 300 LB. FLANGES - LINE SPACING (UNINSULATED)

Table: A-4

APPENDIX B

GALLERY CONCEPT DEVELOPMENT

- NARRATIVE
- FIGURES

APPENDIX B

GALLERY CONCEPT DEVELOPMENT

To establish a beginning point to the Brown & Root Development, Inc. (BARDI) conceptual designs for the utilities gallery, we reviewed the requirements for utilities and determined that cable storage would be the most constraining to our design. Consequently, we decided to meet this requirement first, while still considering the accommodation of the other utilities. In investigating several methods of electrical cable storage, our intention was to utilize a minimum of manual effort to handle the cable.

We reviewed several different methods such as flaking (or coiling), mechanical laydown and manual laydown. For flaking (Figure B-1), we established three methods of storage which would be used on either the upper or lower deck. Our initial reaction to these methods was that they were as labor intensive as the existing handling methods and would provide little improvement.

The mechanical laydown method (Figure B-2) was evaluated in an attempt to limit the need for manhandling with the aid of minor mechanical systems. For this concept, all systems were located on the lower deck. The conveyor and the monorail systems relieved the need for constant handling in placing the cables in storage, which was a separate rack or conveyor. The block-and-tackle method combined handling and storage means to further reduce constant handling. These means of cable handling all required mechanical systems which were not readily available and for which it could be difficult to achieve an efficient design.

Our third concept (Figure B-3) was to simplify the present methods of cable handling. Although the cables would still be handled manually, we felt that with the aid of a movable crane and with designated storage locations, damage to the cables and the labor required to store them would be reduced. With these methods in mind, we concluded that an organized laydown, as reviewed in Figure B-3, could be employed.

In reviewing the reports submitted on the pile-supported and floating pier concepts, we felt that the floating pier would be a good starting point for conceptual studies due to its well-established dimensions.

The elevated walkway concept (initiated by the T. Y. Lin floating pier study) would provide excellent personnel visibility of all decks and of the ship while performing the ship connections. Working with the rack or tray concept for the floating pier (Figure B-4), a tray was located at waist height above the elevated walkway to store the cables in an orderly fashion. The cable would be lifted from, or placed in, the tray with the use of a mobile crane. Piping in this concept would be suspended under the walkway with the electrical connection box located above, effectively separating the two services. At the appropriate locations along the pier, piping manifolds would penetrate the walkway (Figure B-5). The associated hoses would be stored in trays similar to those used for the electrical cable. In this concept, the lower deck space would be free of any gallery obstructions, and access to the gallery way would be from the upper deck.

Criticism of this concept centered on the location of the piping and the storage of the hoses and cables. Piping suspended from the walkway would be difficult to service and replace, and the tray posed potential design problems in holding and supporting the weight of the heavy electrical cables.

To answer the problem of the electrical cable storage, we considered using reels (Figures B-10 and B-11). Our reel studies considered fixed and movable reels located on either the upper or lower deck. We felt that the fixed reels on the lower deck arranged in parallel offered the most promising solution.

The configuration of the walkway at the reel location (Figure B-12) had to be altered in order to make room for the reel. The piping was suspended over the vehicular accessway to be accessible from a repair truck. Making use of the cable reel concept, we felt that most utility hoses could also be stored on reels next to each hose station (Figure B-13). All cable and hose reels would be removed for service through a removable hatch on the upper deck.

We believed that the reel concept was an adequate solution to storing the cable but that it would require further research. The location of the piping was not optimal for repair and service, and the hoses would probably be difficult to reel since some hoses have large bending radii. The removable deck hatch did not provide the most desirable method for removal of the reels since it would weaken the deck when it is subjected to concentrated loads. With those points in mind, the electrical gallery (Figure B-14) was redesigned to permit cable removal by forklift in the vehicular accessway. Piping was relocated under the walkway where it could be organized for service and repair. The piping stations would utilize a hose laydown area (Figure B-15) in place of the reels. This concept provided ample below-deck space (Figures B-16 and B-17) for parking, storage or below-deck service areas.

Difficulty in access for service and repair of the piping, due to the limited headroom and space, was again an unsolvable obstacle. Doubt was also raised about the efficiency and functionality of the hose stations due to the elevation changes. In addition, it was questioned if the walkway could be structurally designed to support all of the proposed activity and equipment.

As we became more familiar with the floating pier concept, we realized that because of its generous dimensions it could accept a wide variety of equipment arrangements that would not necessarily work with the pile-supported pier.

Consequently, we reevaluated our approach and began working to develop the pile-supported pier design with its more stringent restraints. The solution could then be adapted to the floating pier. This approach would result in a system that utilized equipment and materials common to both pier concepts and would, consequently, be a less-complicated system to implement and service.

In an attempt to establish additional electrical cable organizing and handling methods, we studied the concept of attaching the cable to a mechanical loading arm or boom (Figure B-6). This could be placed on either the upper or lower deck and would totally eliminate the need for manhandling the cables.

In our initial attempt (Figure B-7), we located the boom on the upper deck as a collapsible, articulated truss which could then be located with a mobile crane. All electrical connections would be made on the upper deck, permitting this concept to be adapted to existing piers. Piping (Figure B-8) would be located in a chase in the lower deck and the hose stations would also be located on the upper deck. An objection to this concept was the general desire to have an upper deck clear of obstacles.

An additional study utilizing the articulated truss (Figure B-9) located the services below the upper deck and provided an optional laydown area for storage of the articulated truss to maintain a clear upper deck. The major concern with this concept was the operation and stability of the truss which would require tie-downs for stability and add additional above-deck equipment that would severely obstruct the upper deck when in place. Further, it was determined that this method would not be effective in servicing the nested ships.

Returning to the reel concept, we felt that this was the most positive cable storage method. It provided for orderly storage and allowed for quick removal and replacement of damaged equipment. It would be located below deck to satisfy the goal of a clear upper deck.

At the electrical stations (Figure B-18), cable reels would each contain one or two cables and would be located next to an electrical distribution box (Figure B-20) for each of those cables. The cable would be lifted off the reel by crane and connected to the distribution box at approximately waist height for ease of handling. The cable would then rest on the guardrail and would be restrained in place to relieve the connectors of the stresses due to ship movement and cable weight.

Piping (Figure B-19) would be located under the walkway, penetrating it where required. Hose storage was provided on reels for the smaller hoses, with the larger hoses provided from onshore storage as required.

Review of this concept showed poor access for service and repair of the piping and problems with the removal of the cable and hoses from the reels due to the proximity of the walkway and the resulting tight space. The idea of using only one or two cables per reel spread the electrical stations over a distance that was not optimal for mating with the ships.

In an attempt to locate the piping for better repair and service (Figure B-21), we established a separate piping gallery with much of the piping located at the lower-deck level and the remainder located on the interior walls. This provided access to the pipe from the vehicular accessway and eliminated outside obstructions to the pipe.

We abandoned the elevated walkway concept because of its limitations and located the operational area on the lower deck. Access to the cable reels was by forklift through the vehicular accessway.

The hose stations were situated above on the upper deck (similar to Figure B-8) with the hoses stored off pier and brought in as required.

The piping gallery in this concept was not the optimal configuration. It obstructed use of the center portion of the lower deck. We determined that locating all piping on the lower deck with access over the pipe would be a desirable arrangement. In addition, the above-deck station was contrary to the clear upper deck goal. Although the hoses should be stored off of the pier for such a concept, we felt that in reality they might not be removed, but rather left on the pier, causing continual clutter on the upper deck.

In order to locate the hose stations in the operational areas of the lower deck while still providing vehicular access, we then moved the new piping gallery outboard of the vehicular accessway (Figure B-22). This permitted us to run the piping with a minimum of bends to the hose stations (Figure B-23). Access from the vehicular accessway was provided over the piping but access was now limited to the reels and a removable hatch would be required to permit their removal.

Attempting to limit the need for removable hatches, we determined that if the cables were located inboard of the piping gallery (Figure B-24), we could then utilize the vehicular accessway to remove the reels. In this concept, the piping (Figure B-25) would have less distance to cover, requiring less materials to reach the station locations.

Reviewing this layout, we felt that the gallery was becoming too spread out for optimal space utilization of the lower deck.

We observed that the space over the piping at the electrical stations was completely unused and could be utilized to store the electrical cable reels and to locate the electrical distribution box (Figure B-26). This provided a means of reducing the gallery width while maintaining pipe and electrical cable access to the vehicular accessway. Hose stations would be located as in the previous concept but would use the outer wall of the pier for support (Figure B-27).

This concept appeared to satisfy the requirements for optimal location and space utilization. We then determined the exact dimensions required by the equipment and for its operation and used them to develop our concept (Figure B-28) for the pile-supported pier.

The vehicular access width was established at a minimum of 12 feet where walls or obstructions occur around the vehicle. The cable reels will hold ten cables each and will be 5 feet-6 inches in diameter. This permitted reducing the electrical station size to more efficiently service the ships (Figure B-31). Access for removal will be through the vehicular accessway.

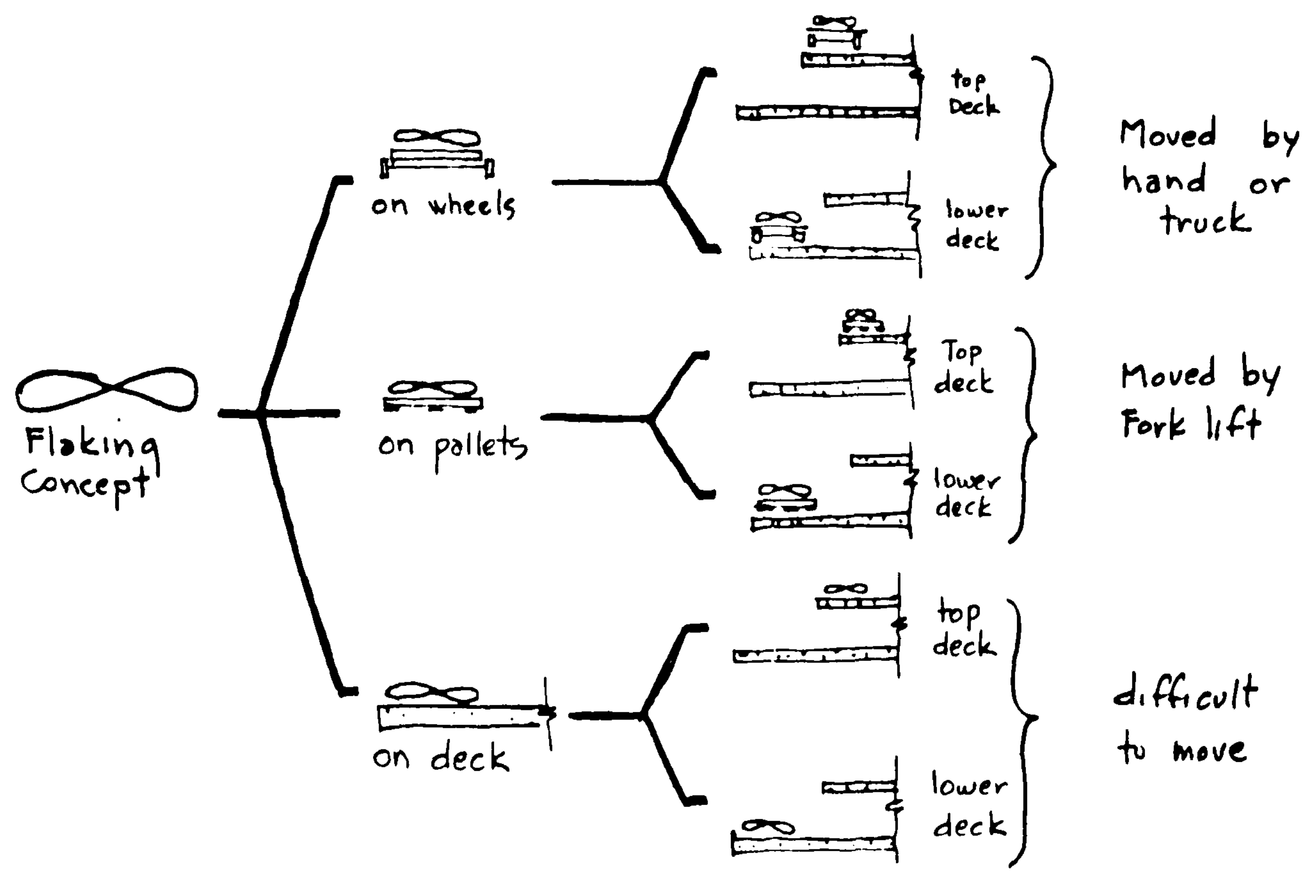
The piping gallery will require 3 feet-6 inches to permit the pipe to be routed to the station and remain under the walkway (Figure B-29). The piping manifolds will be trained towards the ship to minimize hose bending and to provide for visual contact with the ship during hookup. The hose reel concept was dropped in favor of a laydown area. In this way, hoses not requiring cleaning after each usage will be stored in place and not off pier.

Access to the gallery will be provided from the upper deck at the electrical and utility stations by a ladder.

In areas not occupied by the utility stations, the walkway over the piping can be used for storage (Figure B-30). The space between the galleries could be left open or used for storage, parking or service areas.

This concept was adapted to the floating pier with minimal alteration (Figure B-32). The piping gallery was enlarged to accommodate the upper deck column. Also, additional support will be required to stabilize the hose stations (Figure B-33). The arrangement of the utility stations and the below-deck spaces (Figures B-34 and B-35) were identical to that of the pile-supported pier.

In reviewing the tidal conditions which might be encountered at various Naval stations within the United States, it was noted that the high water conditions in some geographical regions imposed some construction constraints on our pile-supported pier concept. Addressing this concern, we reviewed our concept for means of reducing the overall height for these special conditions (Figures B-36 and B-37). This alternate concept did not allow the desired vehicular access, but did follow the basic arrangement of equipment and stations established for our original configuration. After further review, with the concern for maintaining the under-deck vehicular access, we established a minimum acceptable dimension for the piping gallery. The new alternate (because of the limited space) requires that the hose stations be located directly above their respective piping, and reverses the piping layout with the piping requiring heavy hoses located outboard. With this location, special consideration was required to provide structural support for the utility stations. With this modification, we reduced the gallery height by one foot. If additional clearance is required, we suggest raising the elevation of the upper deck. We feel that the gallery height has been reduced as much as possible while still offering the best compromise solution which permits vehicular access for reel removal.



Flaking Concept
on wheels
on pallets
on deck
top Deck
lower deck
Top deck
lower deck
top deck
lower deck
Moved by hand or truck
Moved by Fork lift
difficult to move

FIGURE B-1

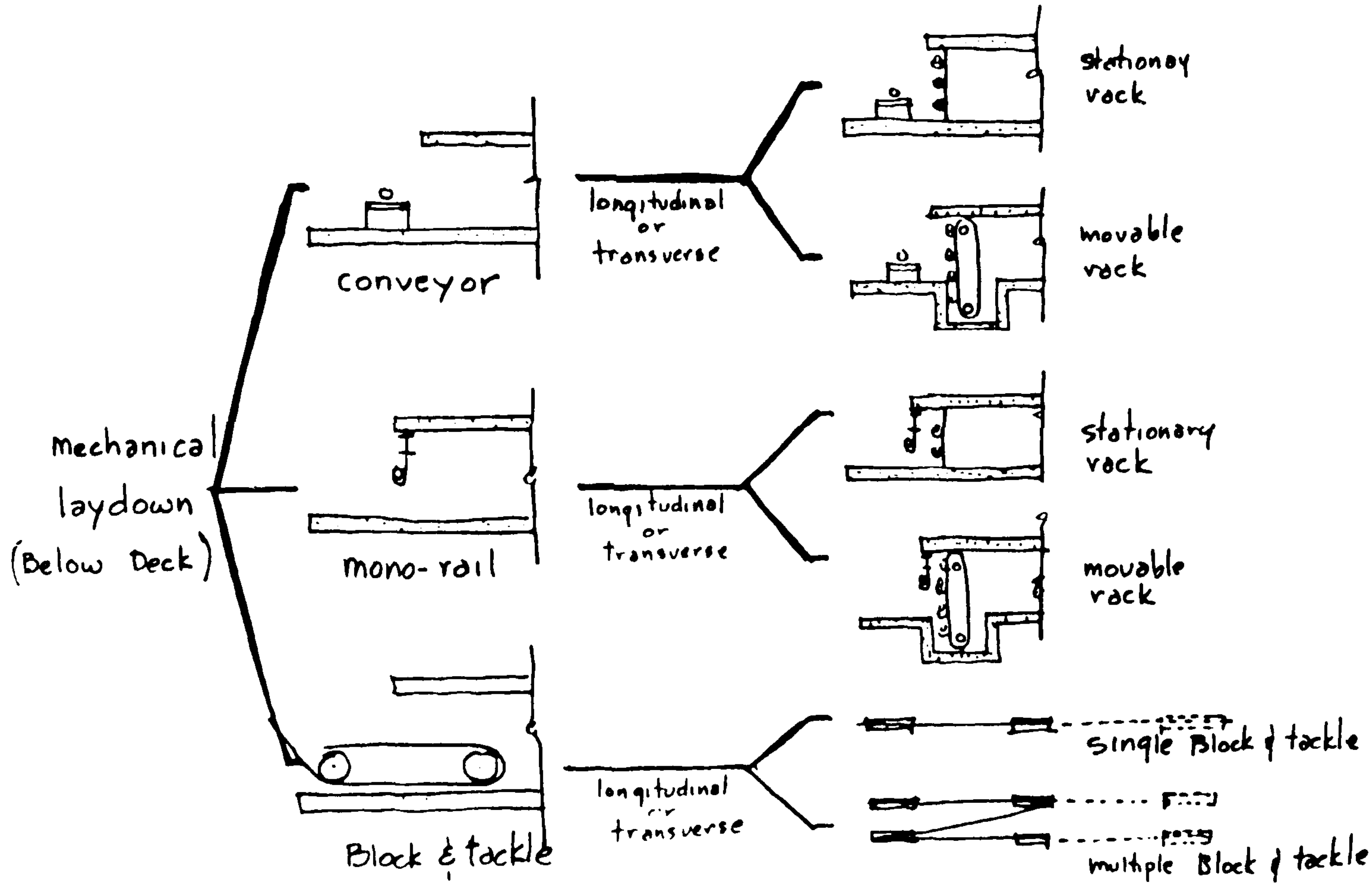

mechanical
laydown
(Below Deck)
conveyor
mono-rail
Block & tackle
longitudinal
or
transverse
longitudinal
or
transverse
longitudinal
or
transverse
stationoy
rack
movable
rack
stationary
rack
movable
rack
single Block & tackle
multiple Block & tackle

FIGURE B-2

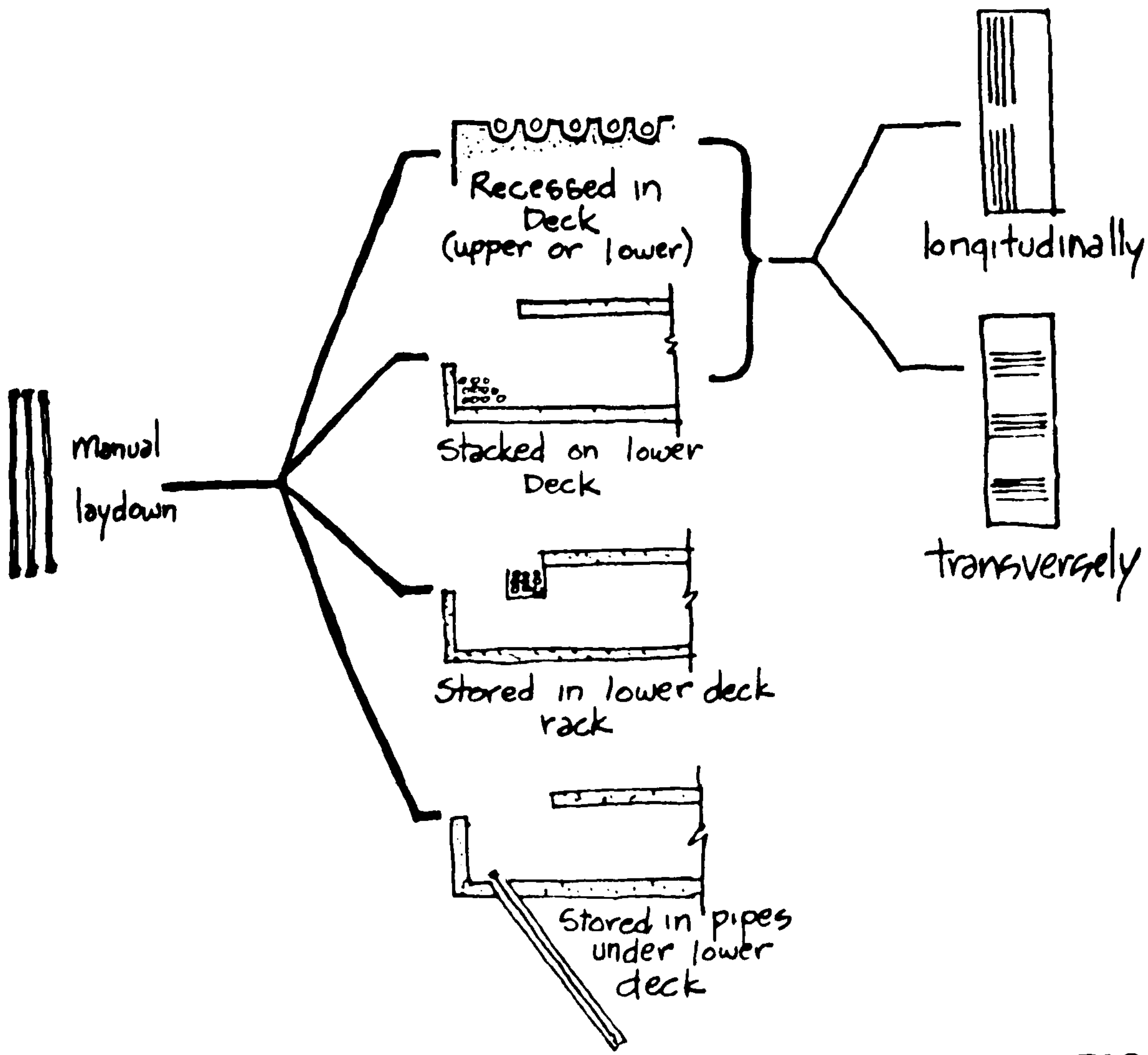
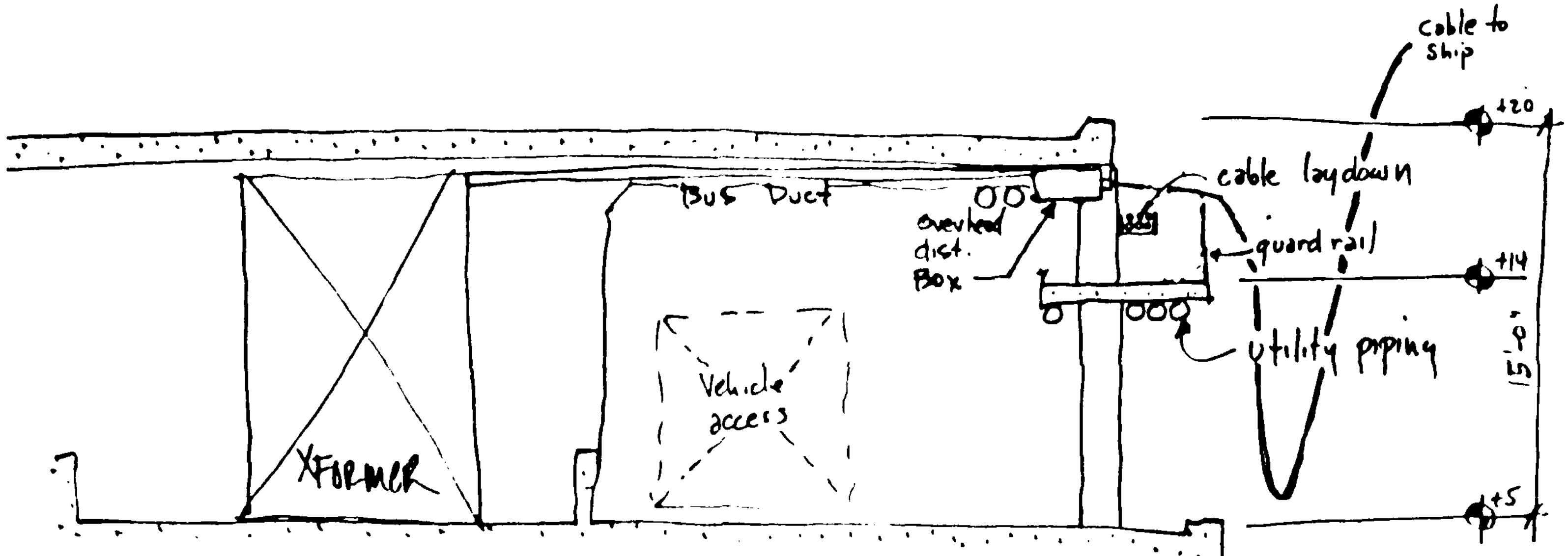
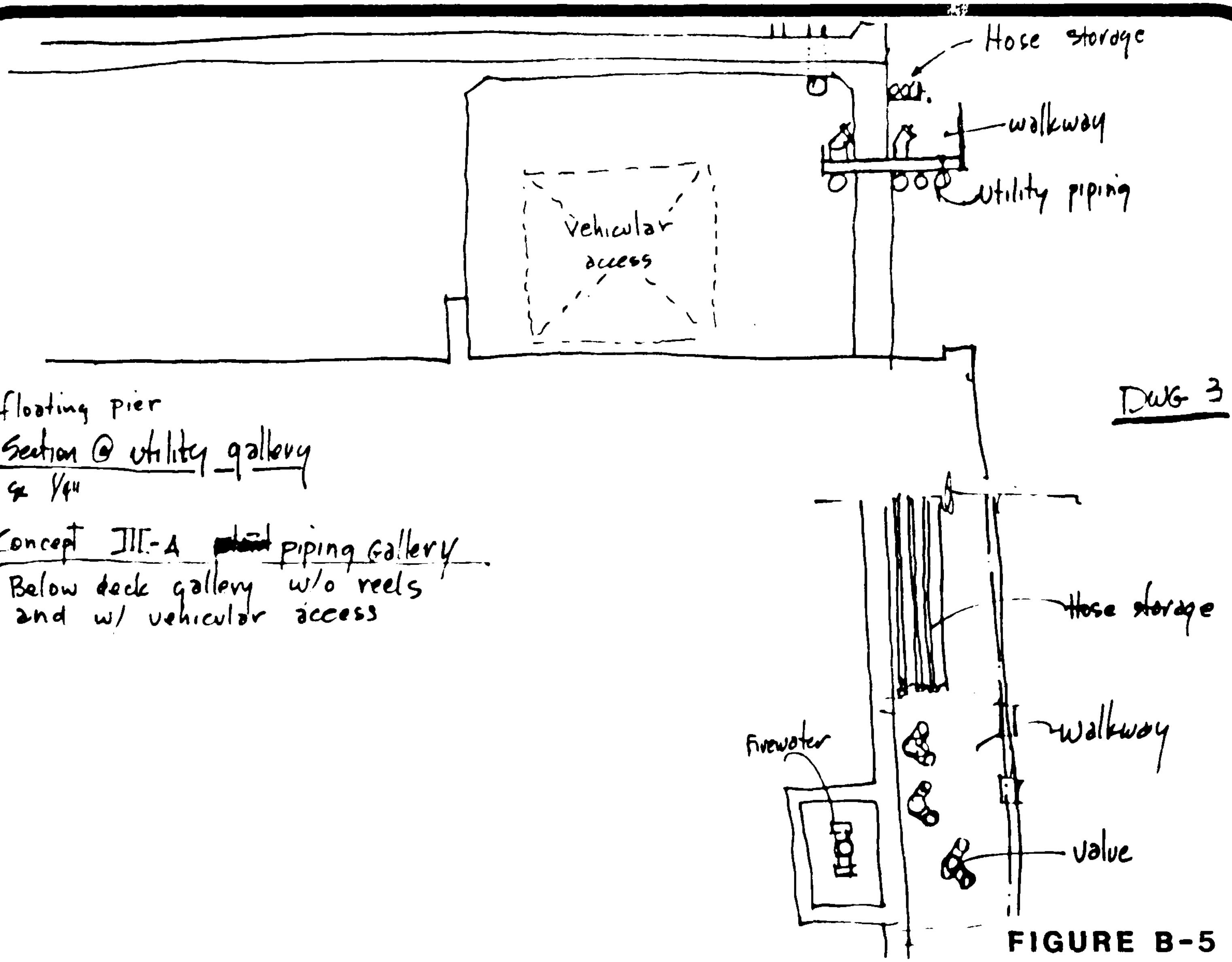

Manual
laydown
Recessed in
Deck
(upper or lower)
Stacked on lower
Deck
Stored in lower deck
rack
Stored in pipes
under lower
deck
longitudinally
transversely

FIGURE B-3



Concept XIII
Section @ electrical gallery (Piping gallery similar)
¼" = 1'

FIGURE B-4



floating pier

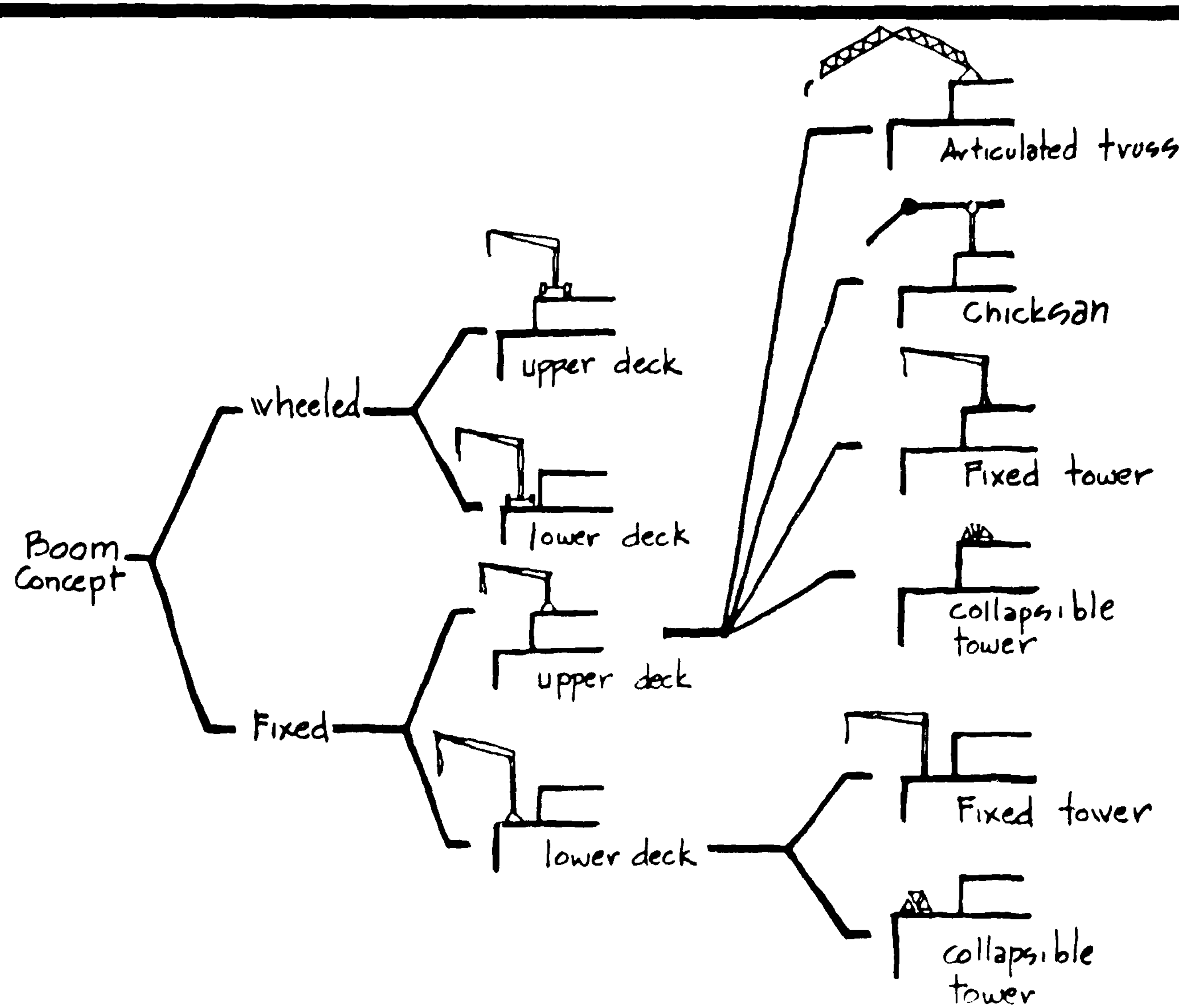
Section @ utility gallery

¼ 1/4"

Concept III-A ~~[illegible]~~ piping Gallery

Below deck gallery w/o reels
and w/ vehicular access

FIGURE B-5



Boom Concept
wheeled
Fixed
upper deck
lower deck
upper deck
lower deck
Articulated truss
Chicksan
Fixed tower
collapsible tower
Fixed tower
collapsible tower

FIGURE B-6

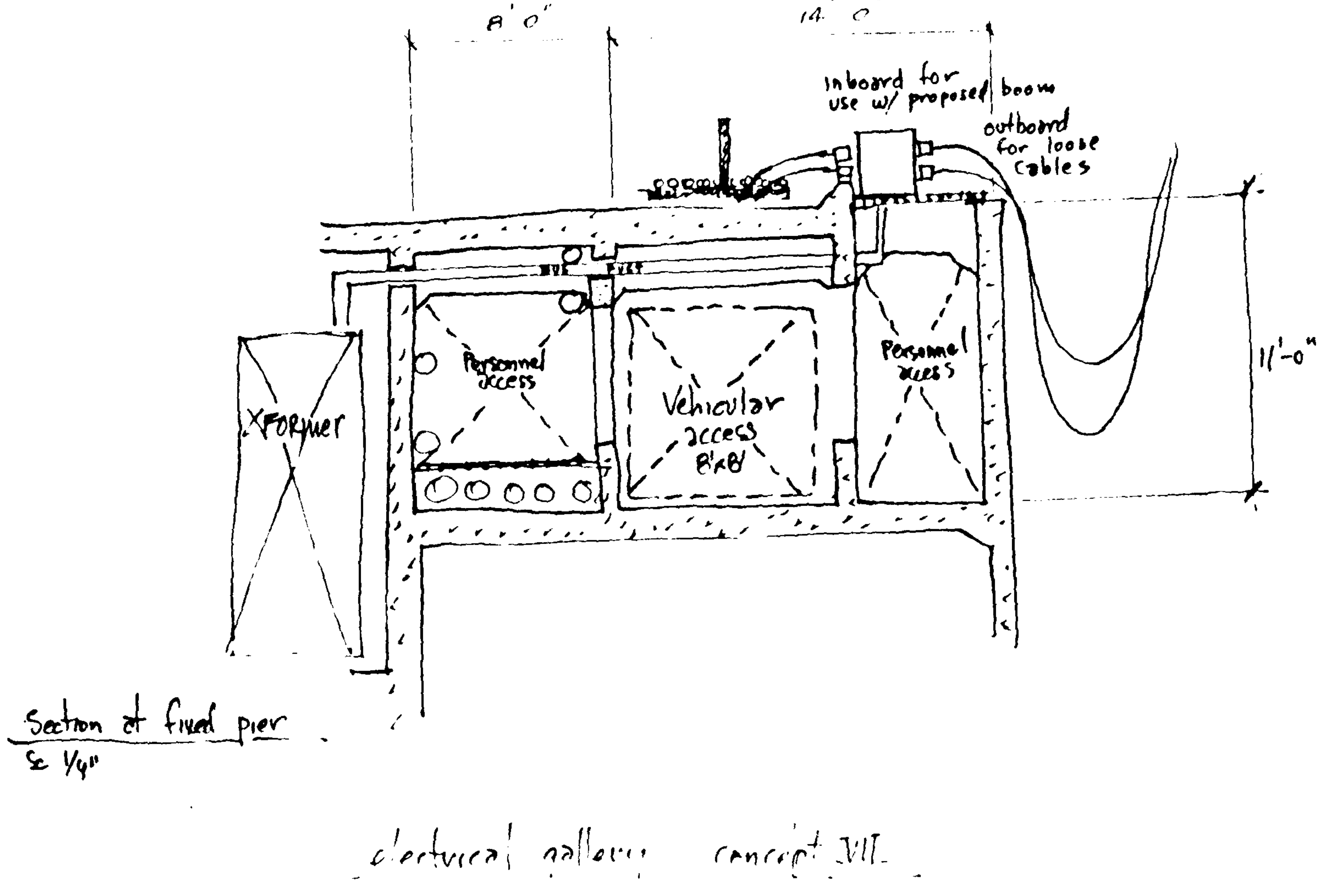
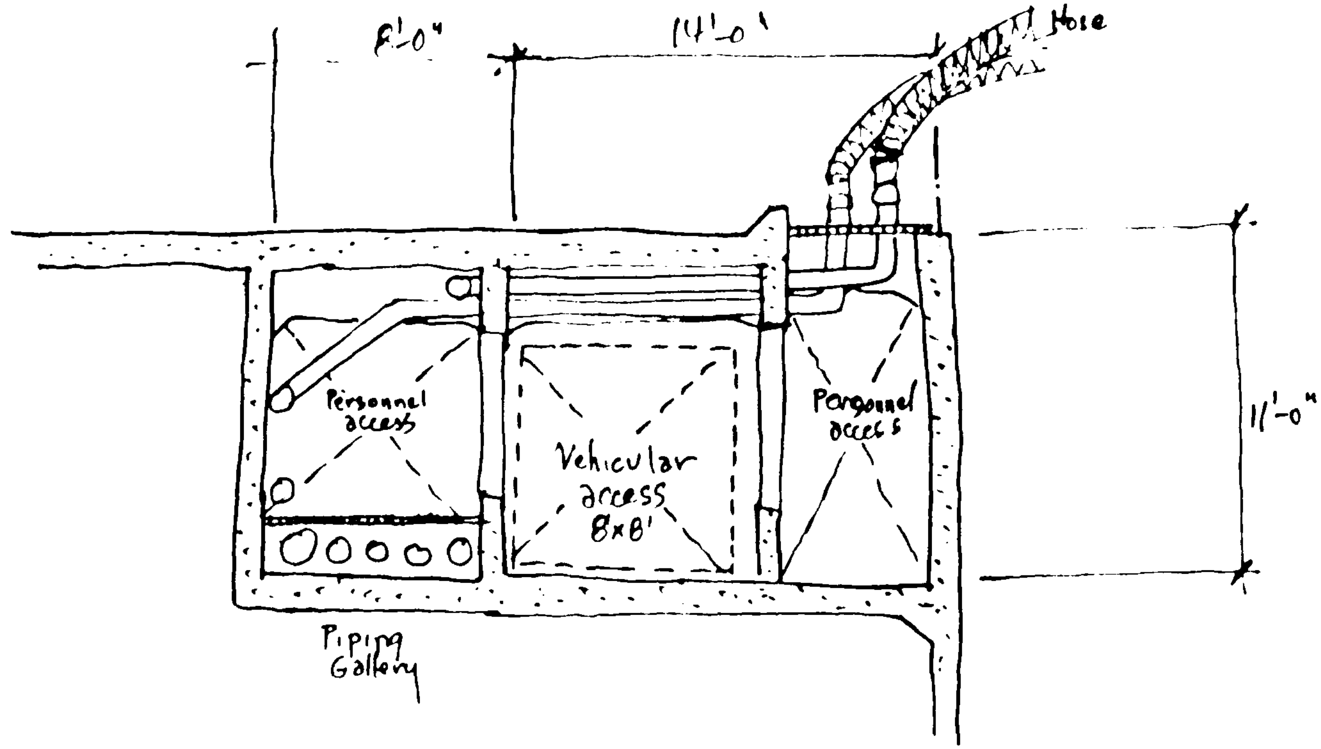

8'0"
14'0"
Inboard for use w/ proposed boom
outboard for loose cables
11'-0"
Personnel access
Vehicular access 8'x8'
Personnel access
XFORMER
Section at fixed pier
Sc 1/4"
electrical gallery concept VII

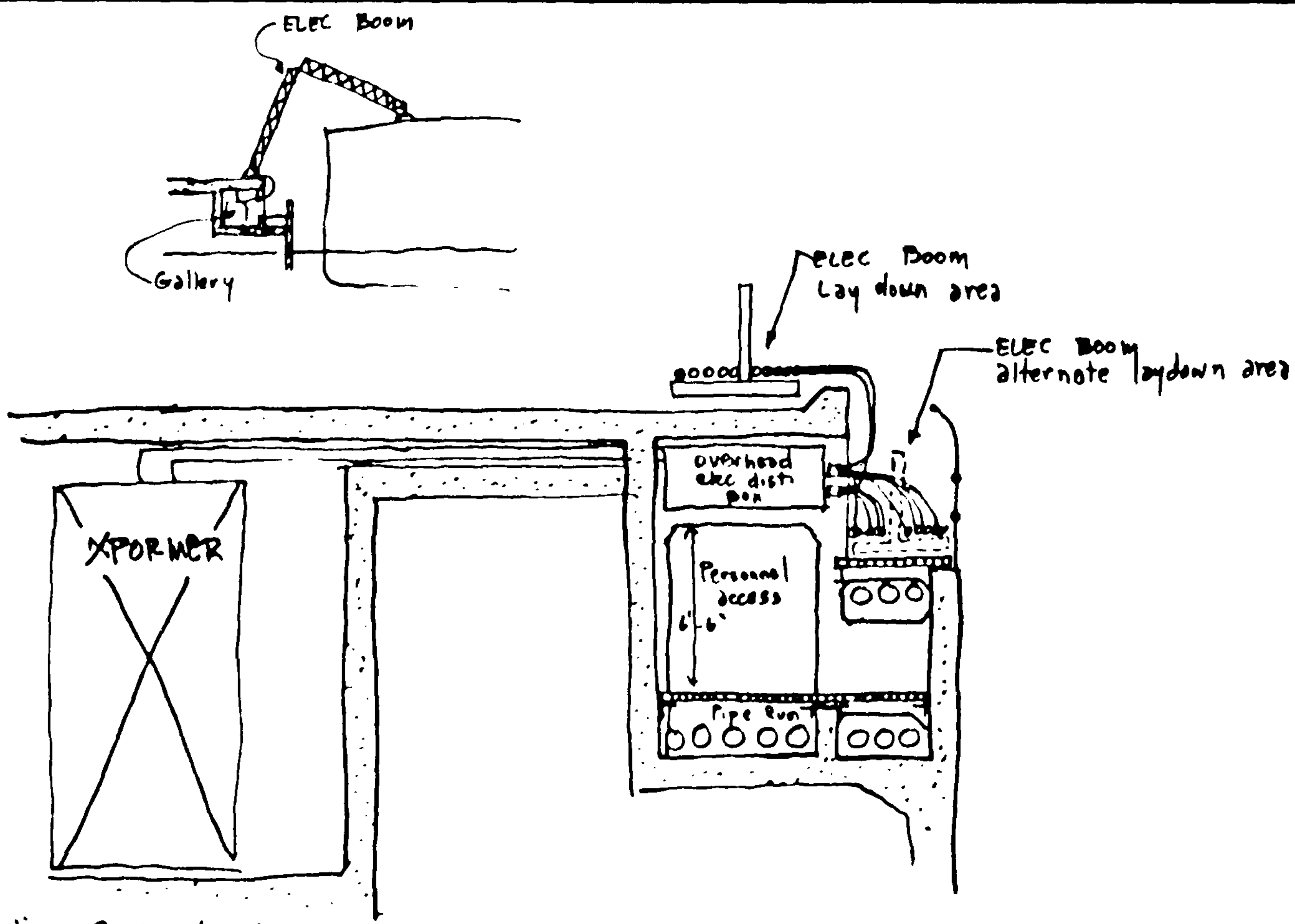
FIGURE B-7



Section at fixed pier
Sc 1/4"

Concept # VII - piping gallery
Inboard piping gallery
w/ vehicular access - above deck valves

FIGURE B-8



Section @ Fixed pier
sc 1/4"

Concept # II - electrical gallery
Elec boom w/ Piping Gallery
no vehicular access

DWG 1

FIGURE B-9

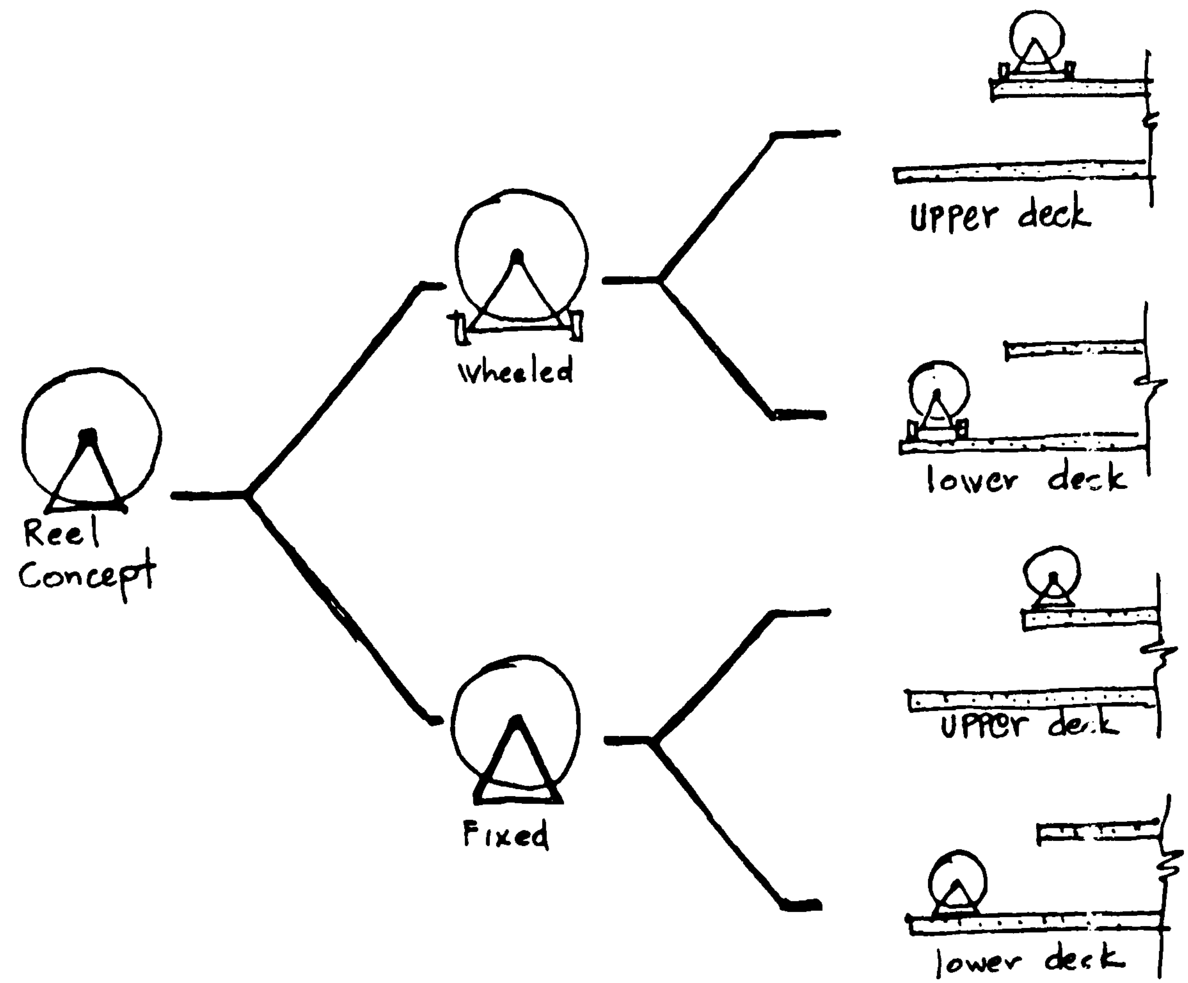
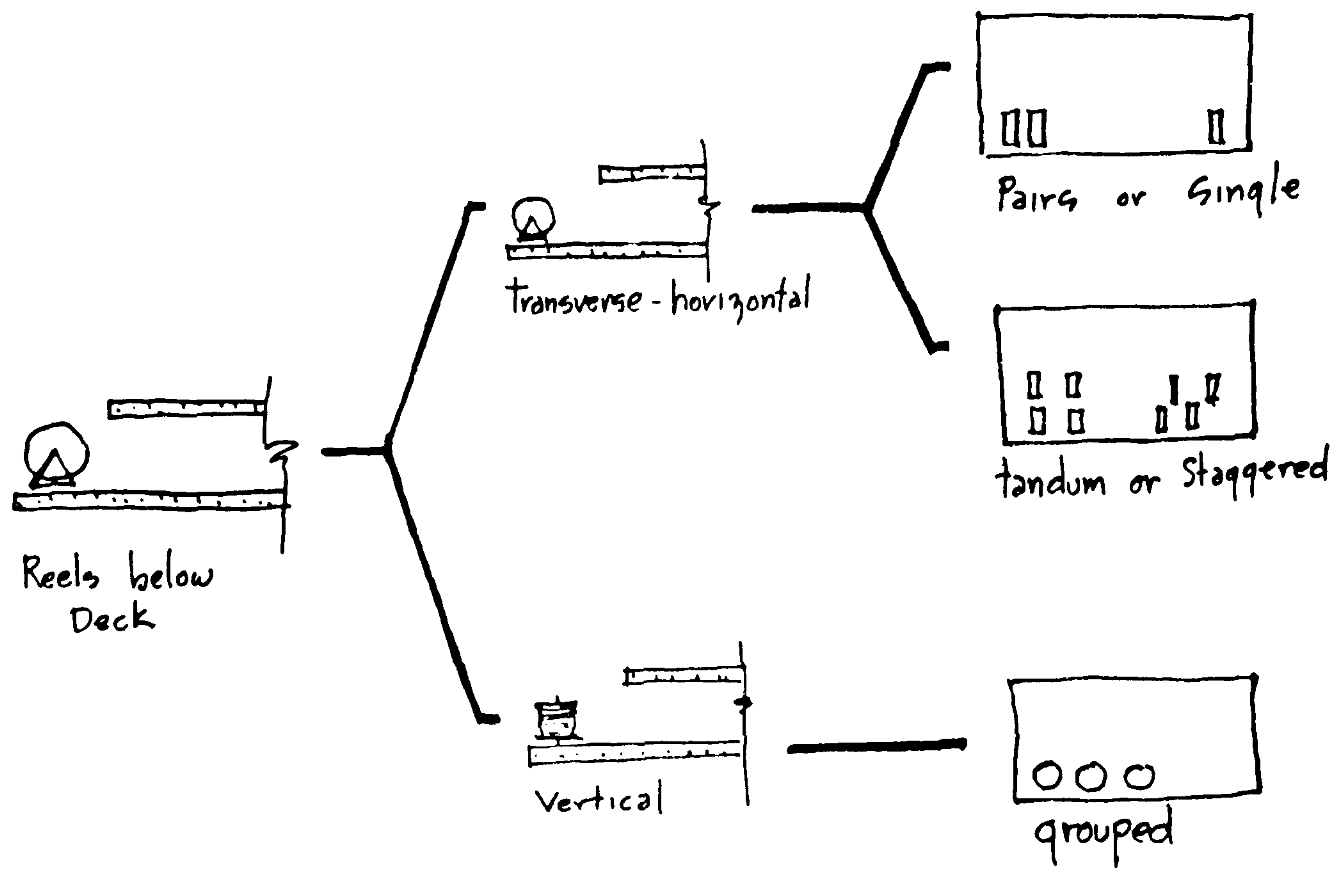

Reel
Concept
Wheeled
Fixed
upper deck
lower deck
upper deck
lower deck

FIGURE B-10



Reels below Deck
transverse - horizontal
Vertical
Pairs or Single
tandum or Staggered
grouped

FIGURE B-11

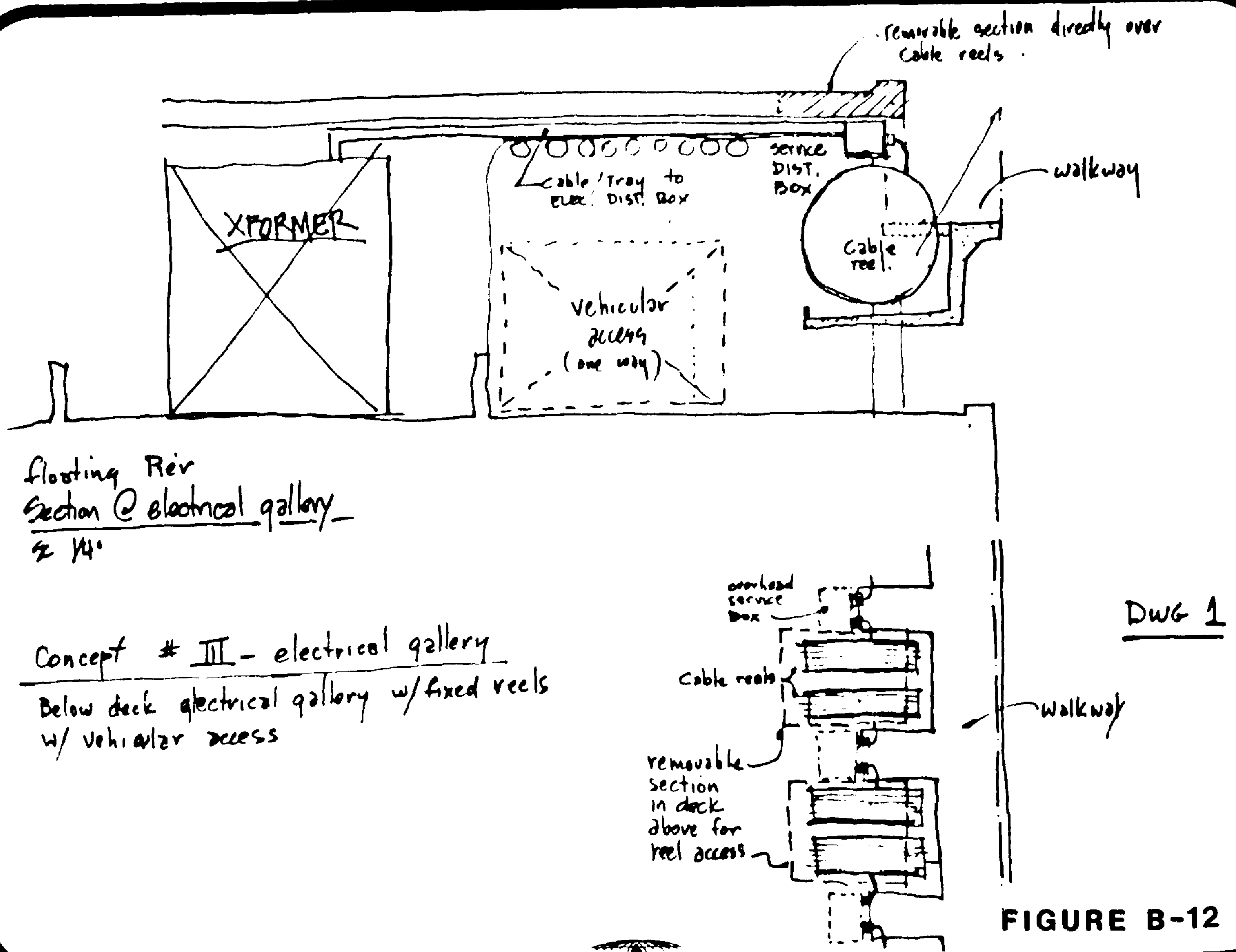
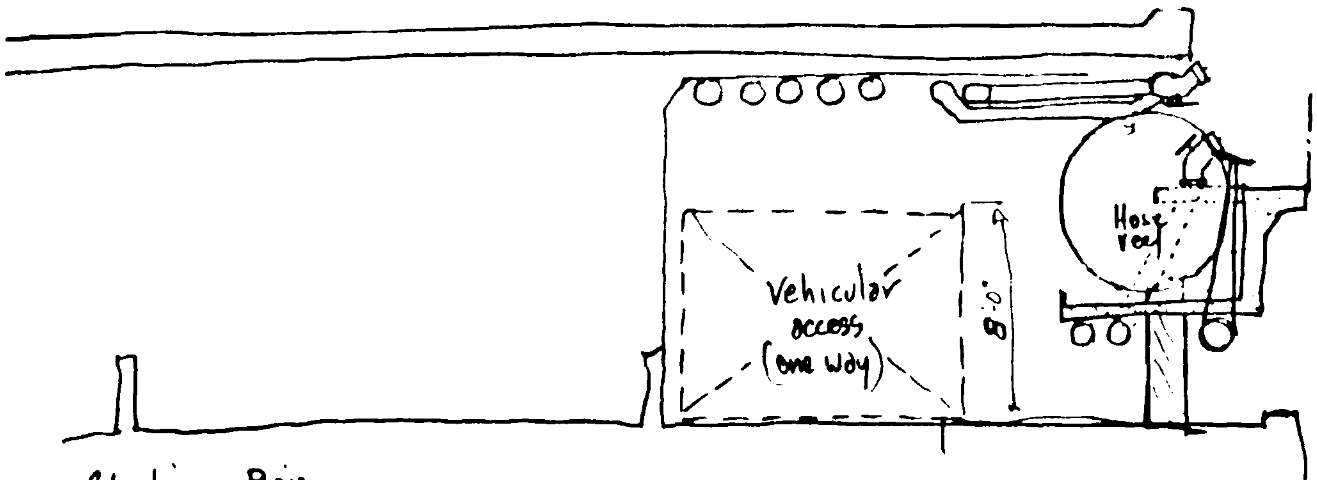

removable section directly over Cable reels.
walkway
service DIST. Box
Cable/Tray to ELEC. DIST. BOX
XFORMER
vehicular access (one way)
Cable reel.
floating Pier
Section @ electrical gallery
1/4"
DWG 1
overhead service box
Cable reels
walkway
removable section in deck above for reel access
Concept # III - electrical gallery
Below deck electrical gallery w/fixed reels w/ vehicular access

FIGURE B-12



floating Pier
Section @ utility gallery
sc 1/4'

Concept III - Piping Gallery
Below deck gallery w/ fixed reels
w/ vehicular access

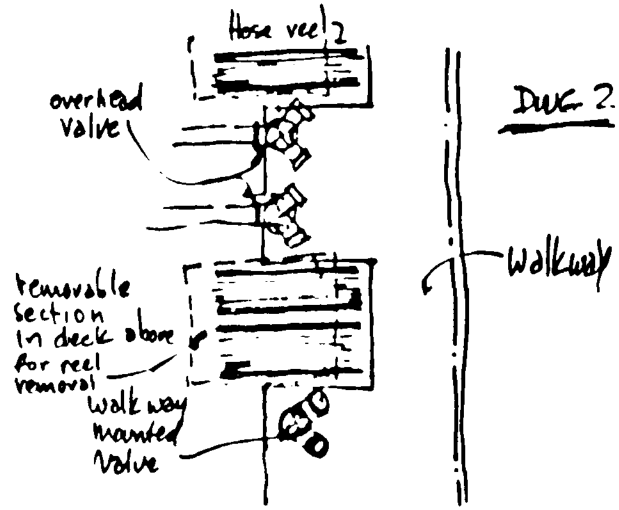
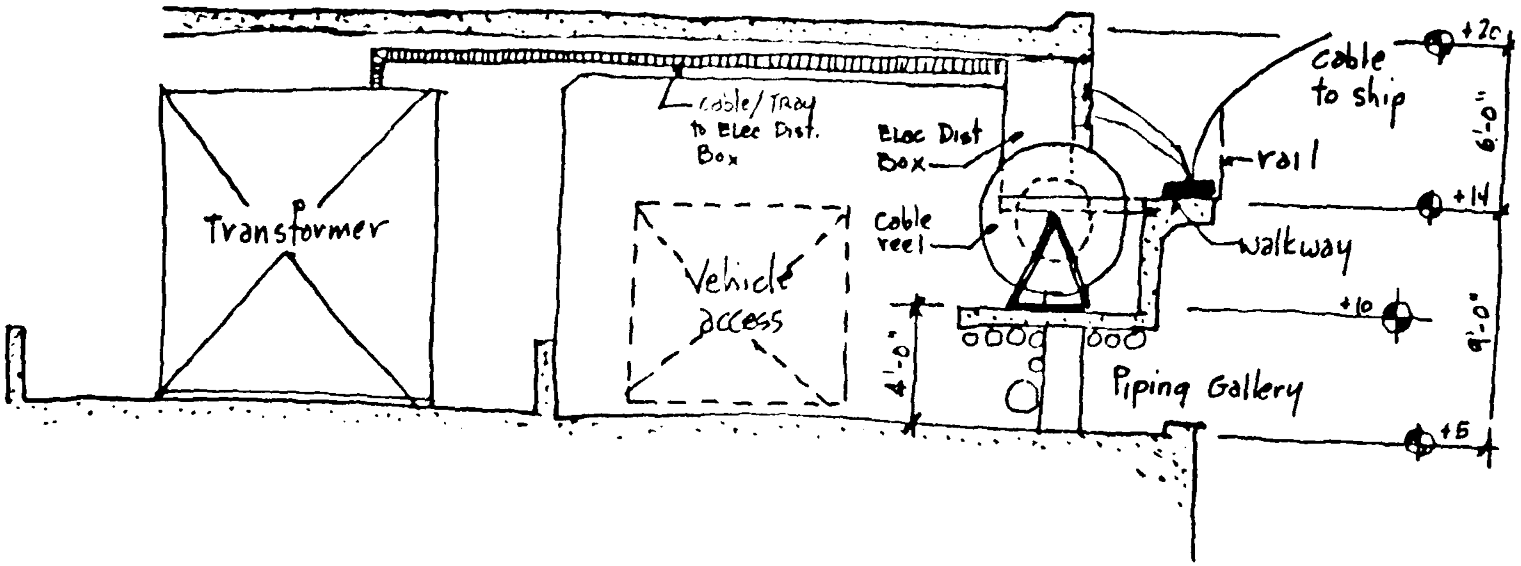


FIGURE B-13



Concept XI
Section B @ Eletrical Gallery w/ vehicular removal of reels
Sc 1/4"
floating Pier

FIGURE B-14

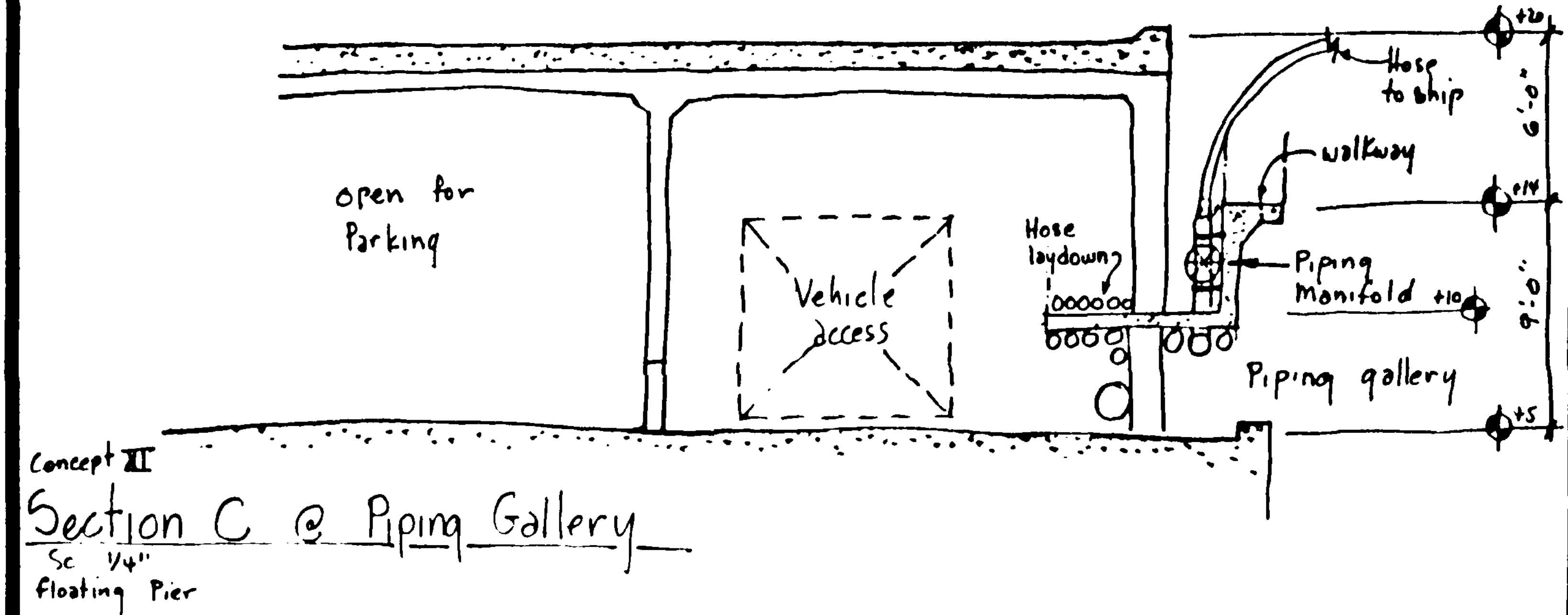
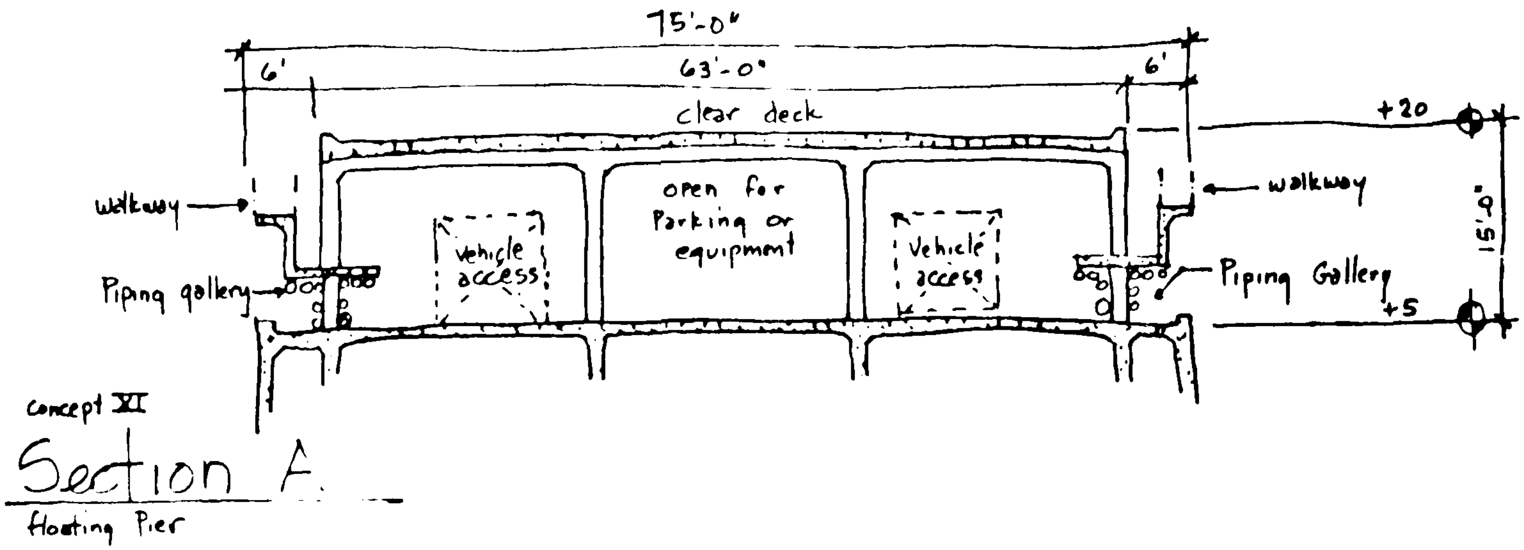
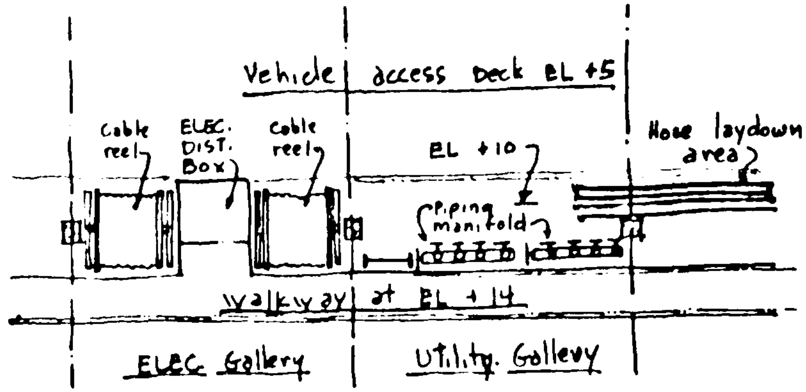

open for Parking
Vehicle access
Hose laydown
Hose to ship
walkway
Piping Manifold +10
Piping gallery
+20
+14
+5
6'-0"
9'-0"
Concept II
Section C @ Piping Gallery
Sc 1/4"
Floating Pier

FIGURE B-15

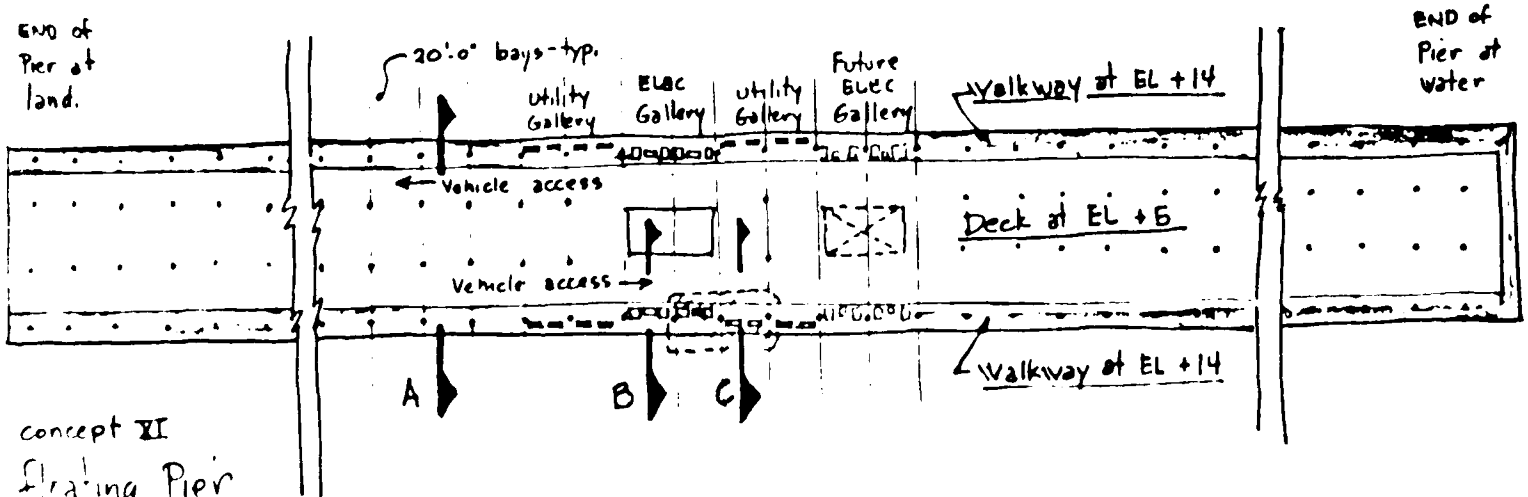


75'-0"
6'
63'-0"
6'
clear deck
+20
walkway
open for
Parking or
equipment
vehicle
access
Vehicle
access
walkway
Piping gallery
Piping Gallery
15'-0"
+5
Concept XI
Section A
Floating Pier

FIGURE B-16

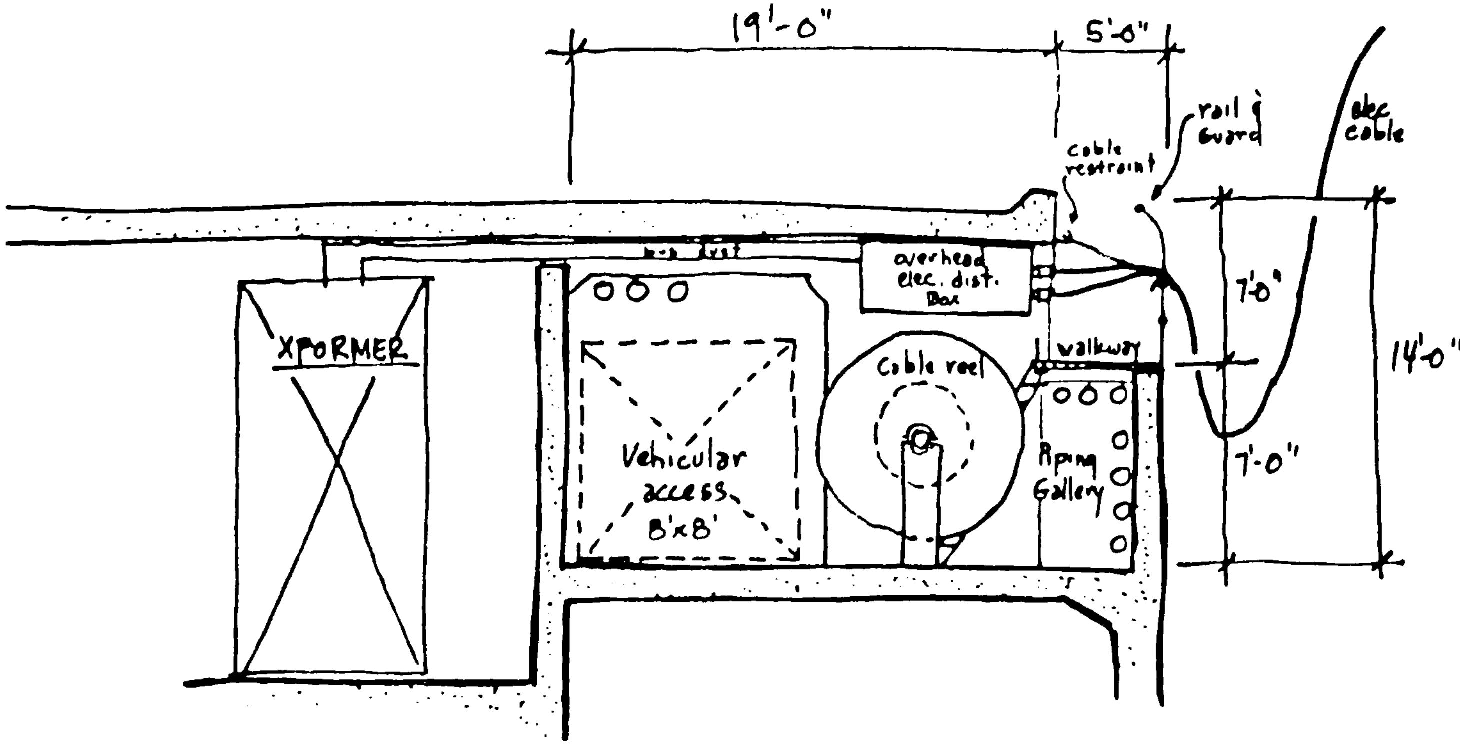


Enlarged plan at Gallerys
sc 1/8"



concept XI
floating Pier
Plan at lower level.

FIGURE B-17



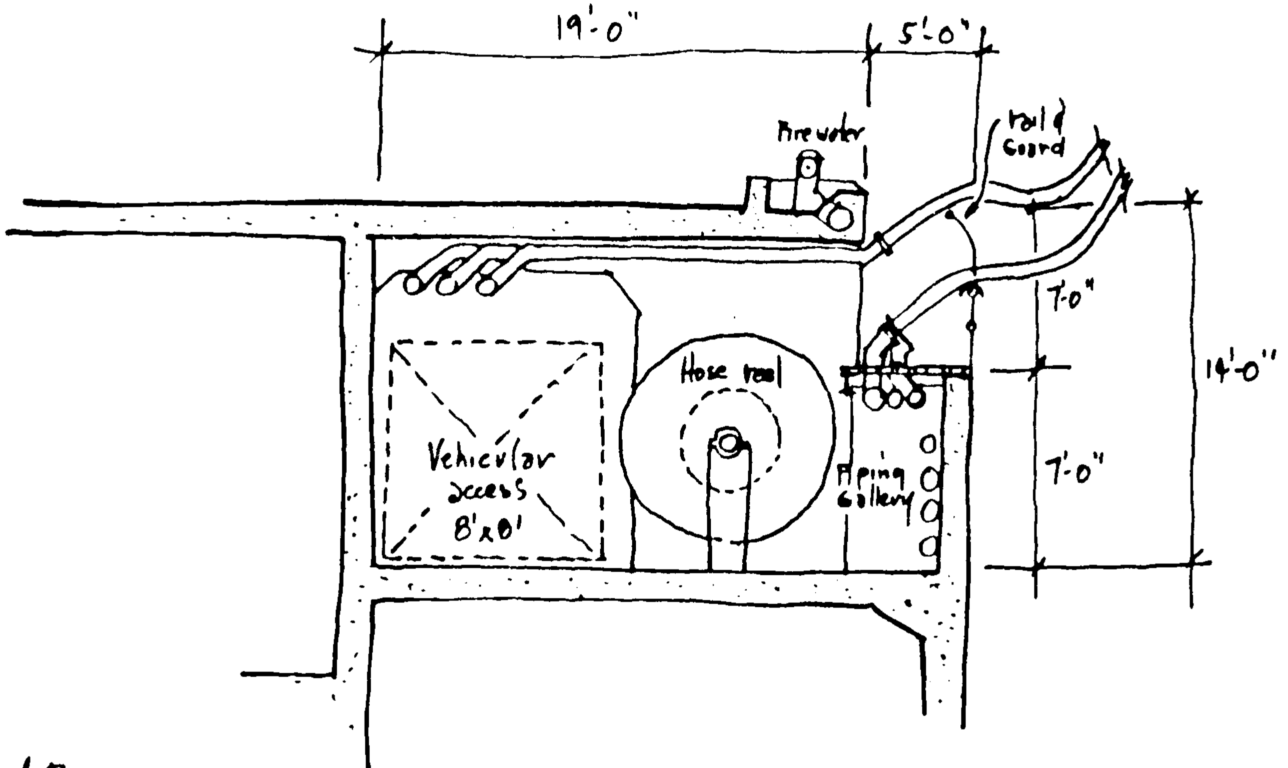
section @ fixed Pier

concept # I - electrical gallery

fixed reels below deck
w/ vehicular access

DWG 1

FIGURE B-18



Section @ fixed Pier
sc 1/4"

Concept # I -Utility gallery
fixed reels below deck
w/ Vehicular access

Dwg 2

FIGURE B-19

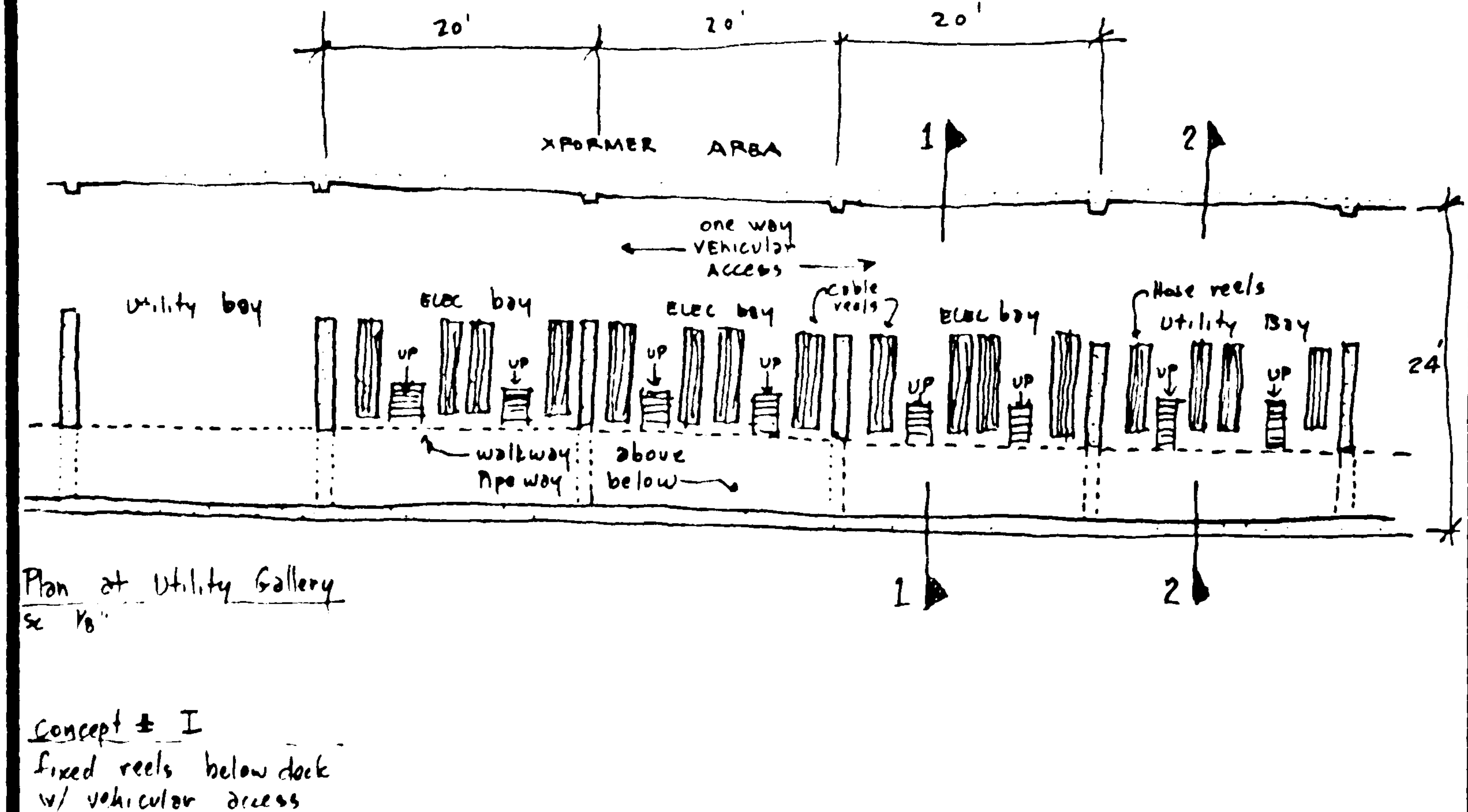

20'
20'
20'
XFORMER AREA
1
2
one way
VEHICULAR
ACCESS
Utility bay
ELEC bay
ELEC bay
cable reels
ELEC bay
Hose reels
Utility Bay
UP
UP
UP
UP
UP
UP
UP
UP
24'
walkway above
Pipe way below
1
2
Plan at Utility Gallery
Sc 1/8"
Concept # I
fixed reels below dock
w/ vehicular access

FIGURE B-20

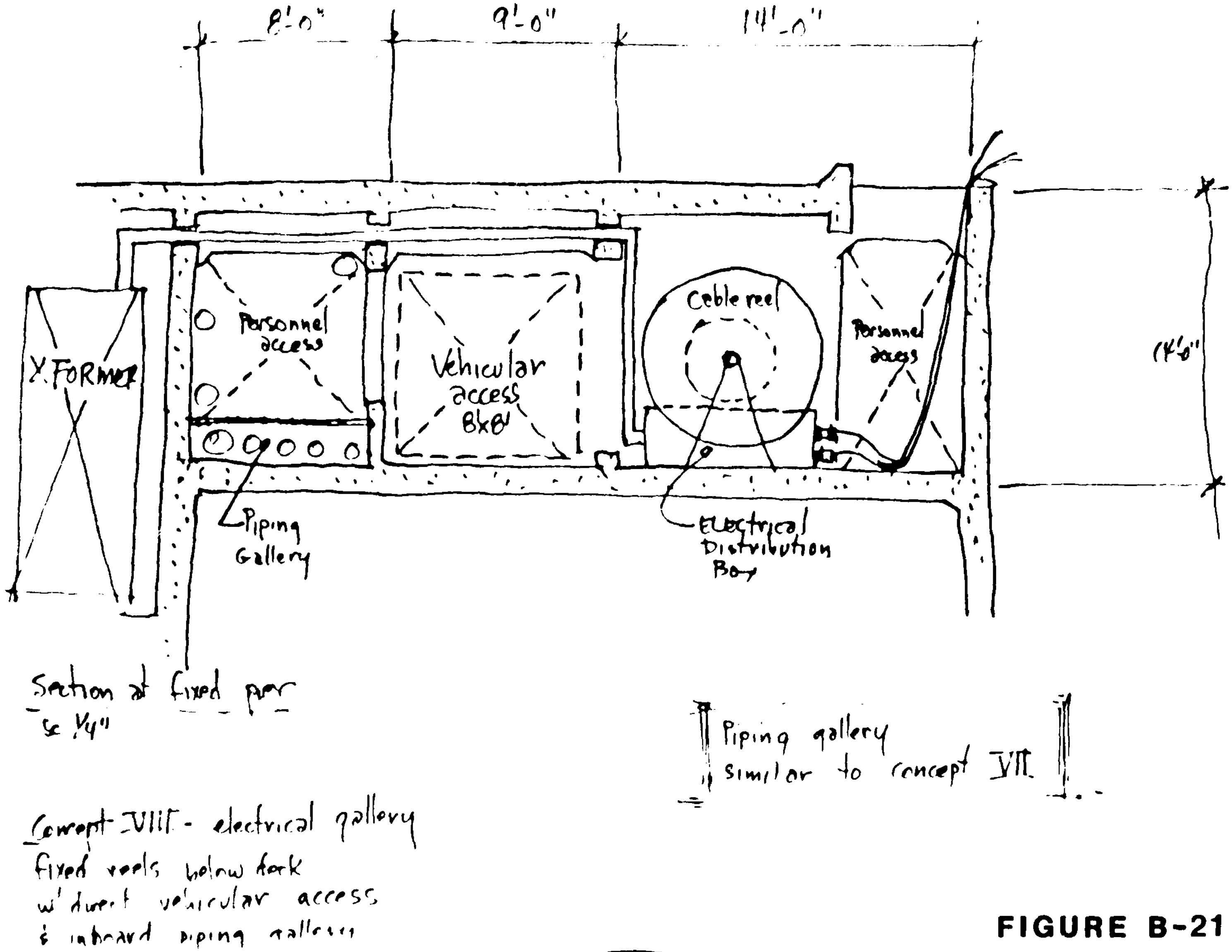
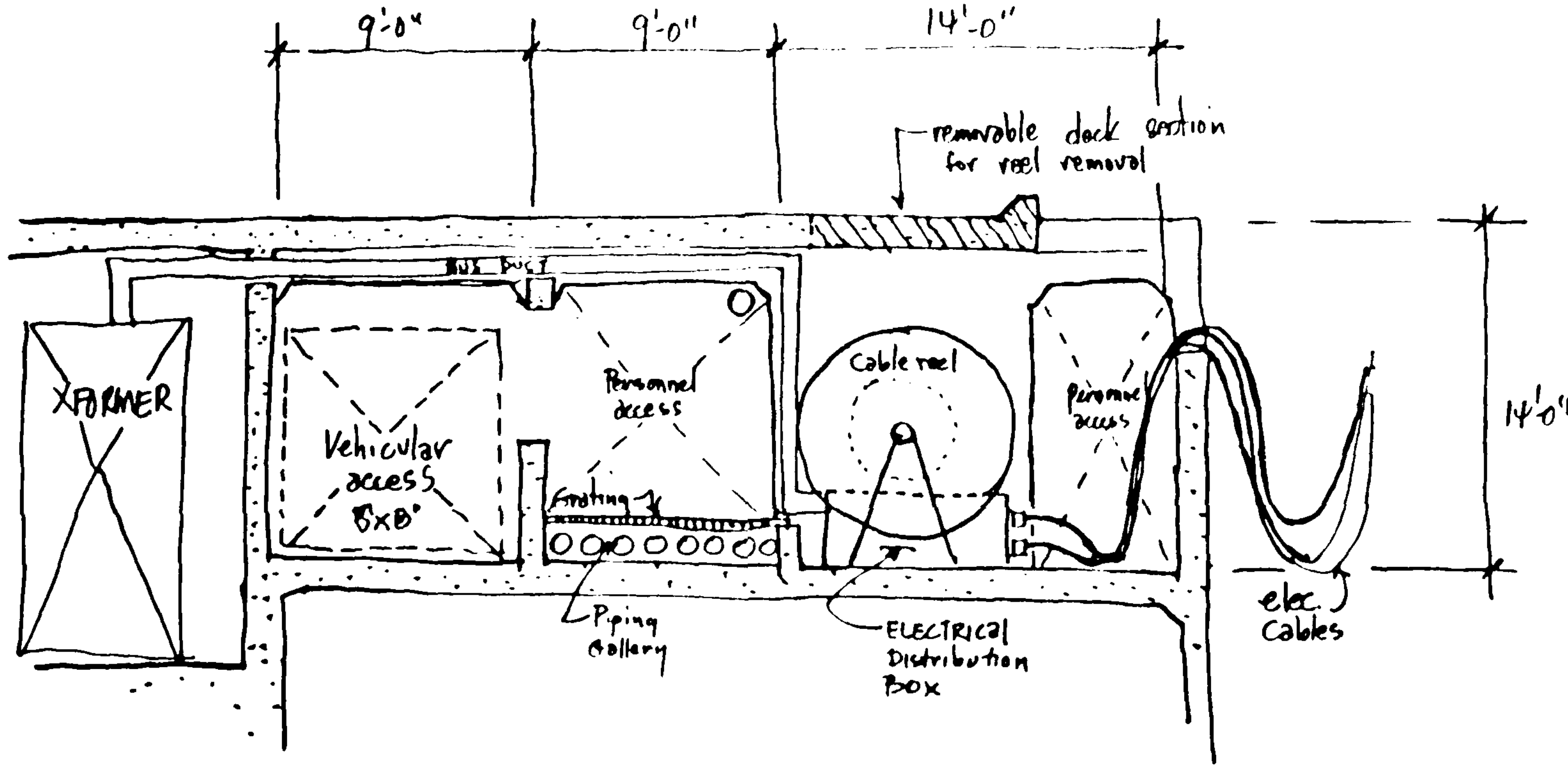

8'-0"
9'-0"
14'-0"
(14'-0")
X.FORMER
Personnel access
Vehicular access 8x8'
Cable reel
Personnel access
Piping Gallery
Electrical Distribution Box
Section at fixed pier
sc 1/4"
Piping gallery similar to concept VII
Concept VIII - electrical gallery
fixed reels below deck
w/ direct vehicular access
& inboard piping gallery

FIGURE B-21

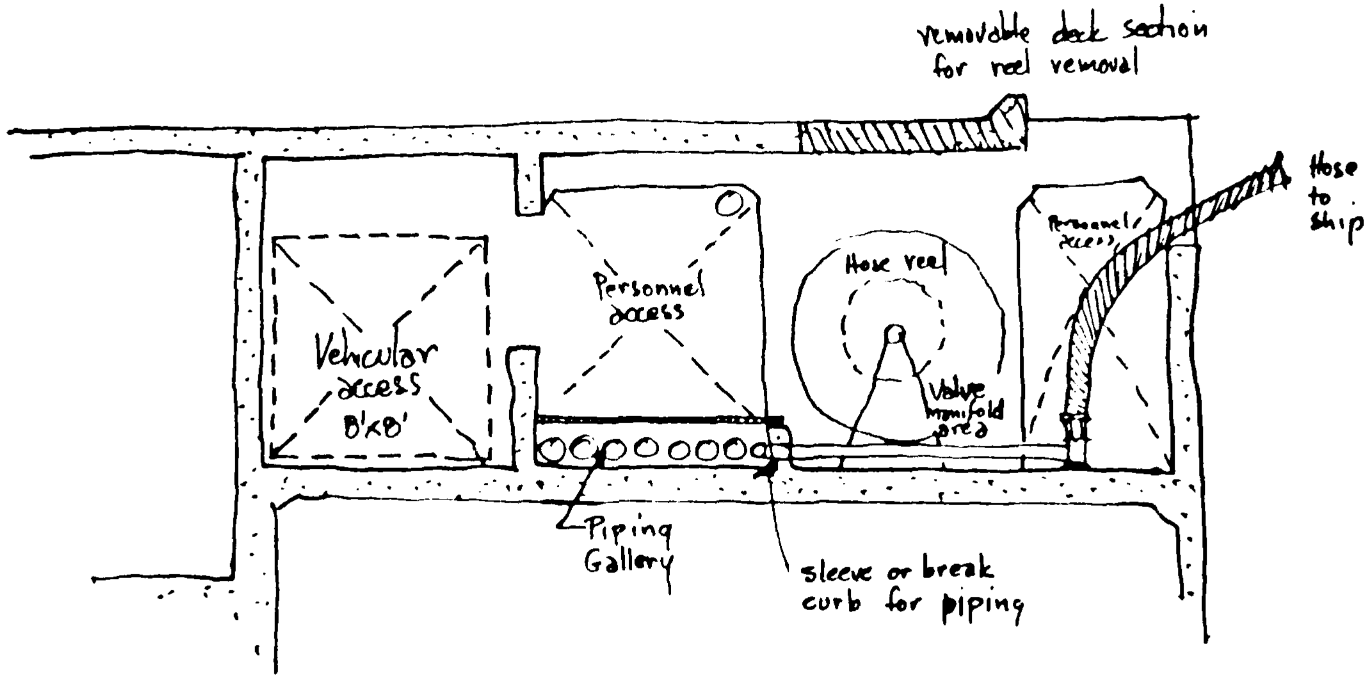


Section at fixed pier
Sc 1/4"

Concept # IV. electrical gallery
fixed reels below deck
w/ vehicular access & open piping gallery

Dwg # 1

FIGURE B-22

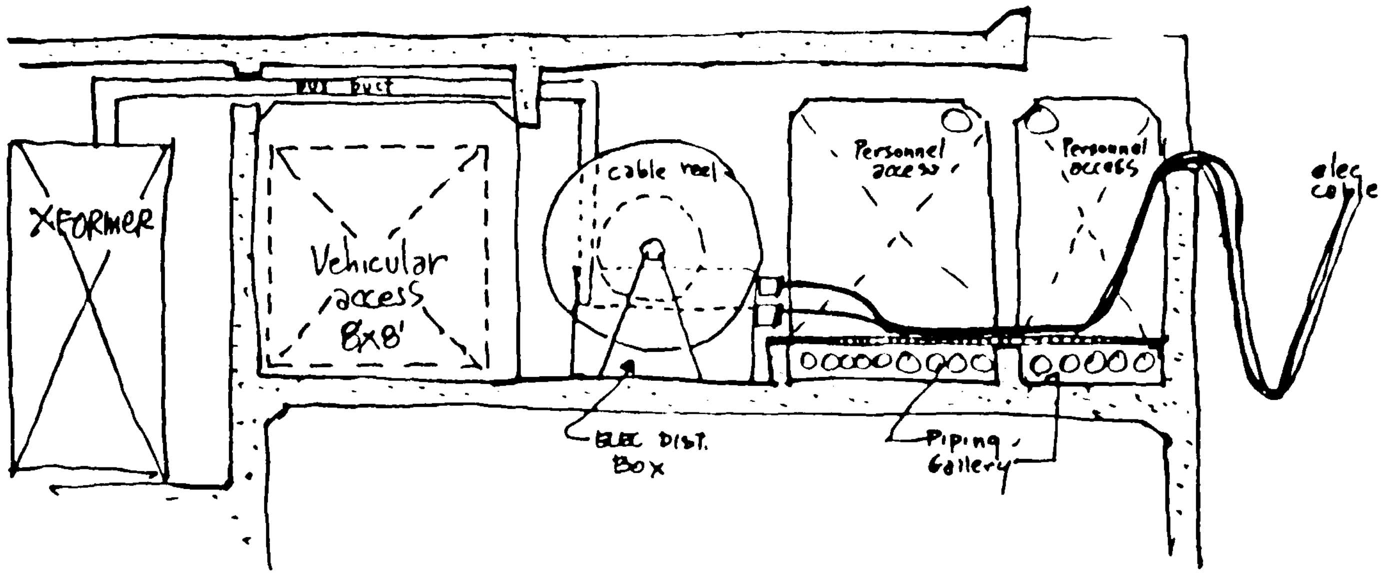


Section at fixed pier.
Sc 1/16"

Concept # IV. - piping gallery -
Fixed hose reels below deck
w/ vehicular access & open piping gallery

Dwg # 2.

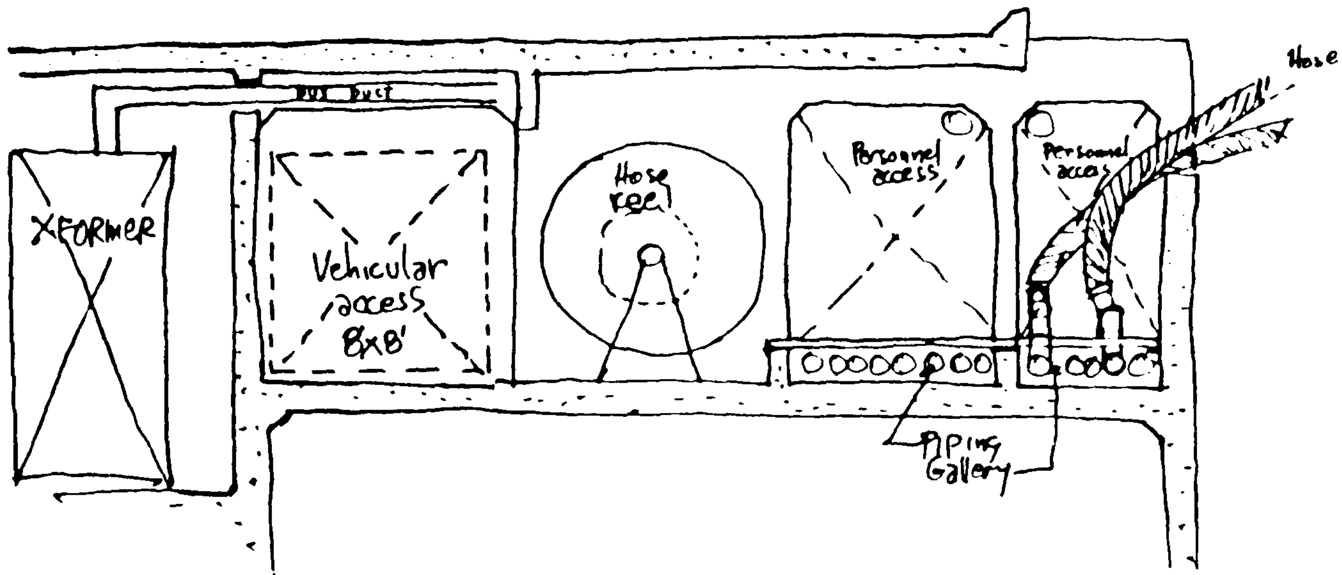
FIGURE B-23



section at fixed prev
Sc 1/4"

Concept # VI electrical gallery (similar at piping gallery) Dwg # 1
fixed reels below deck
w/ vehicular access & open piping gallery
reels removed thru interior access

FIGURE B-24

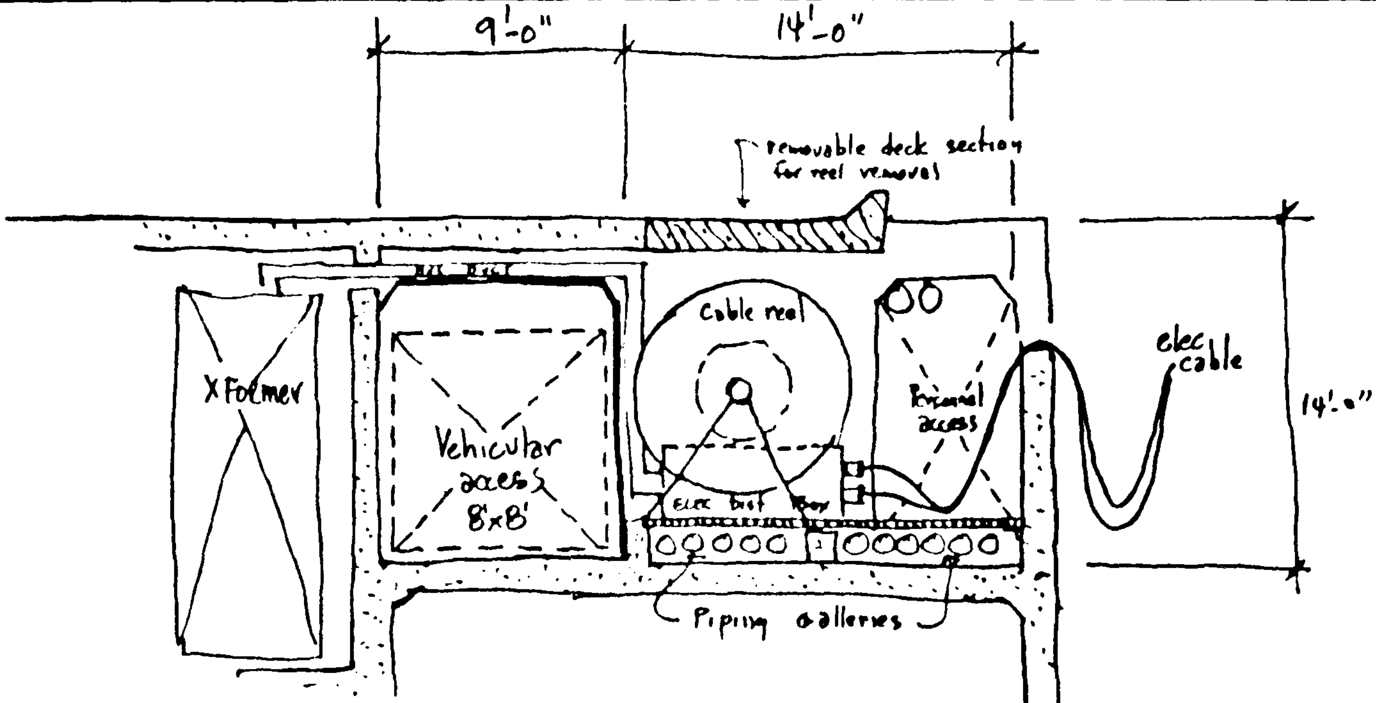


Section at fixed prev
Sc 1/4"

Dwg # 2

Piping gallery concept # VI

FIGURE B-25



Section at fixed pier
Sc 1/4"

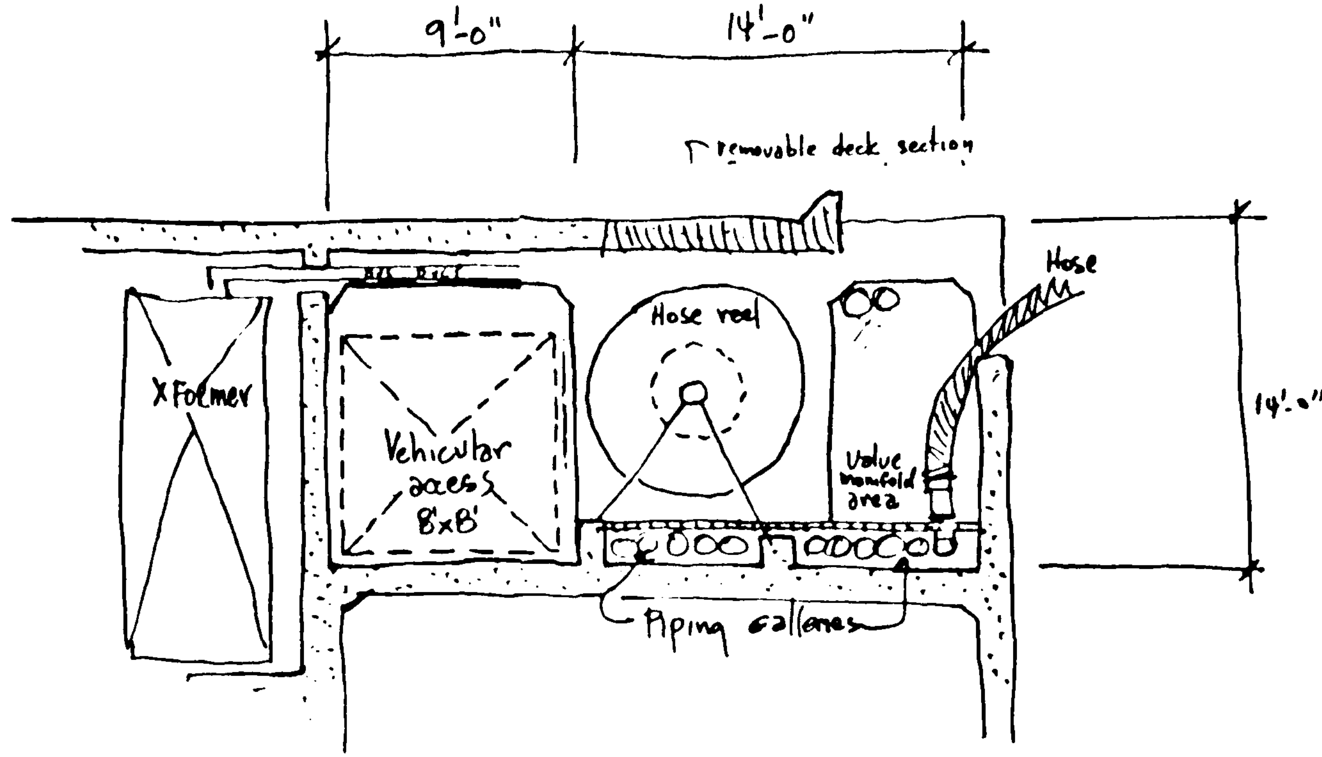
DWG 1

Concept # V electrical gallery (similar @ piping gallery)

fixed reels below deck
w/ vehicular access

Concept # Va — can be utilized w/o reels
would be possible to change depth dimension to 11'-0"

FIGURE B-26



Piping gallery conceptual

FIGURE B-27

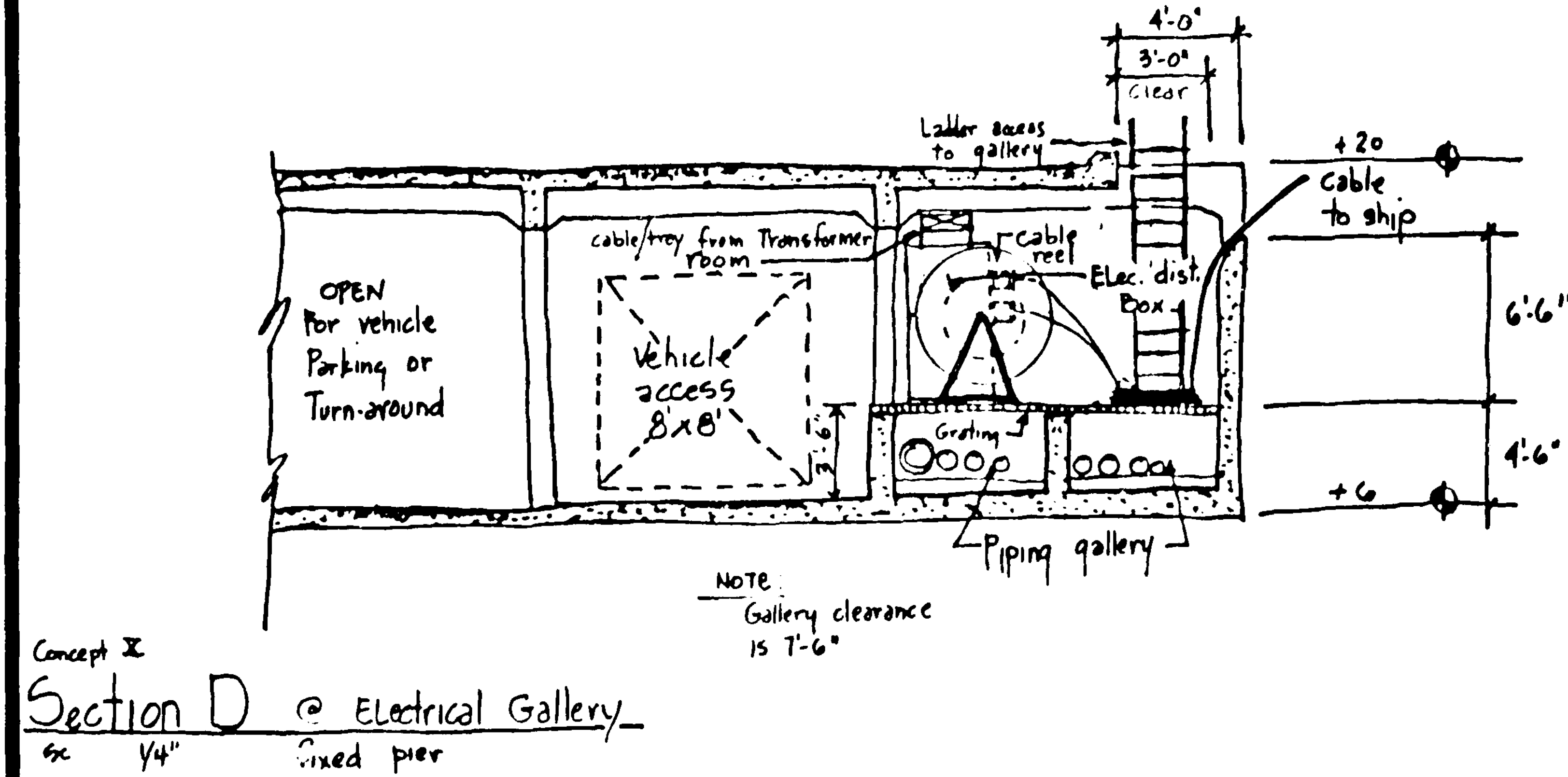
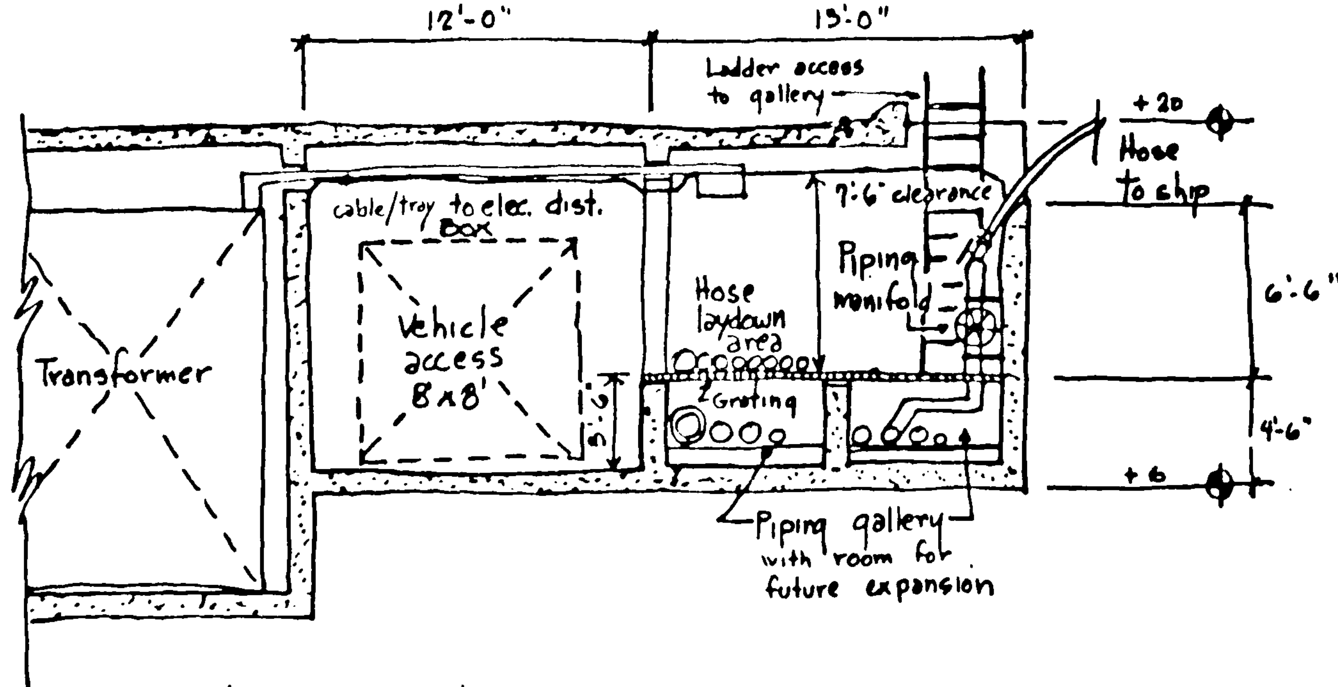
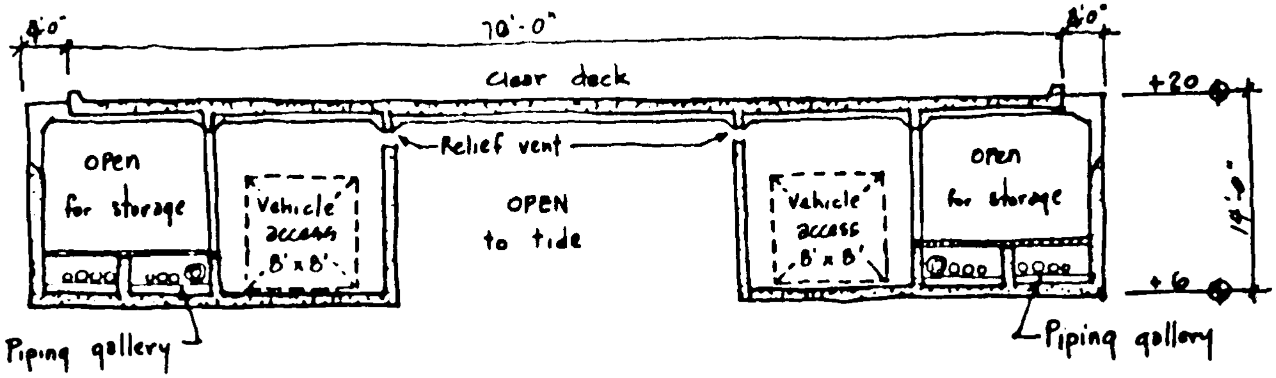

4'-0"
3'-0"
Clear
Ladder access to gallery
+20
Cable to ship
cable/trey from Transformer room
cable reel
Elec. dist. Box
OPEN
For vehicle
Parking or
Turn-around
Vehicle access 8'x8'
6'-6"
4'-6"
Grating
+6
Piping gallery
NOTE:
Gallery clearance
is 7'-6"
Concept X
Section D @ Electrical Gallery
Sc 1/4"
Fixed pier

FIGURE B-28

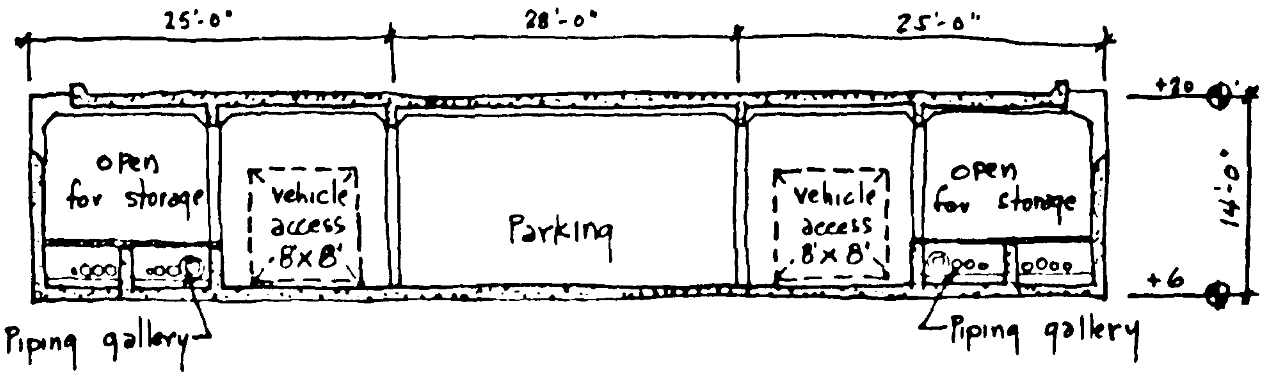


Concept I
Section C @ Piping/Utilities Gallery
sc 1/4" fixed Pier

FIGURE B-29



Concept I
Section A - fixed Pier
sc 1/8"



Concept I
Section B - fixed pier
sc 1/8"

FIGURE B-30

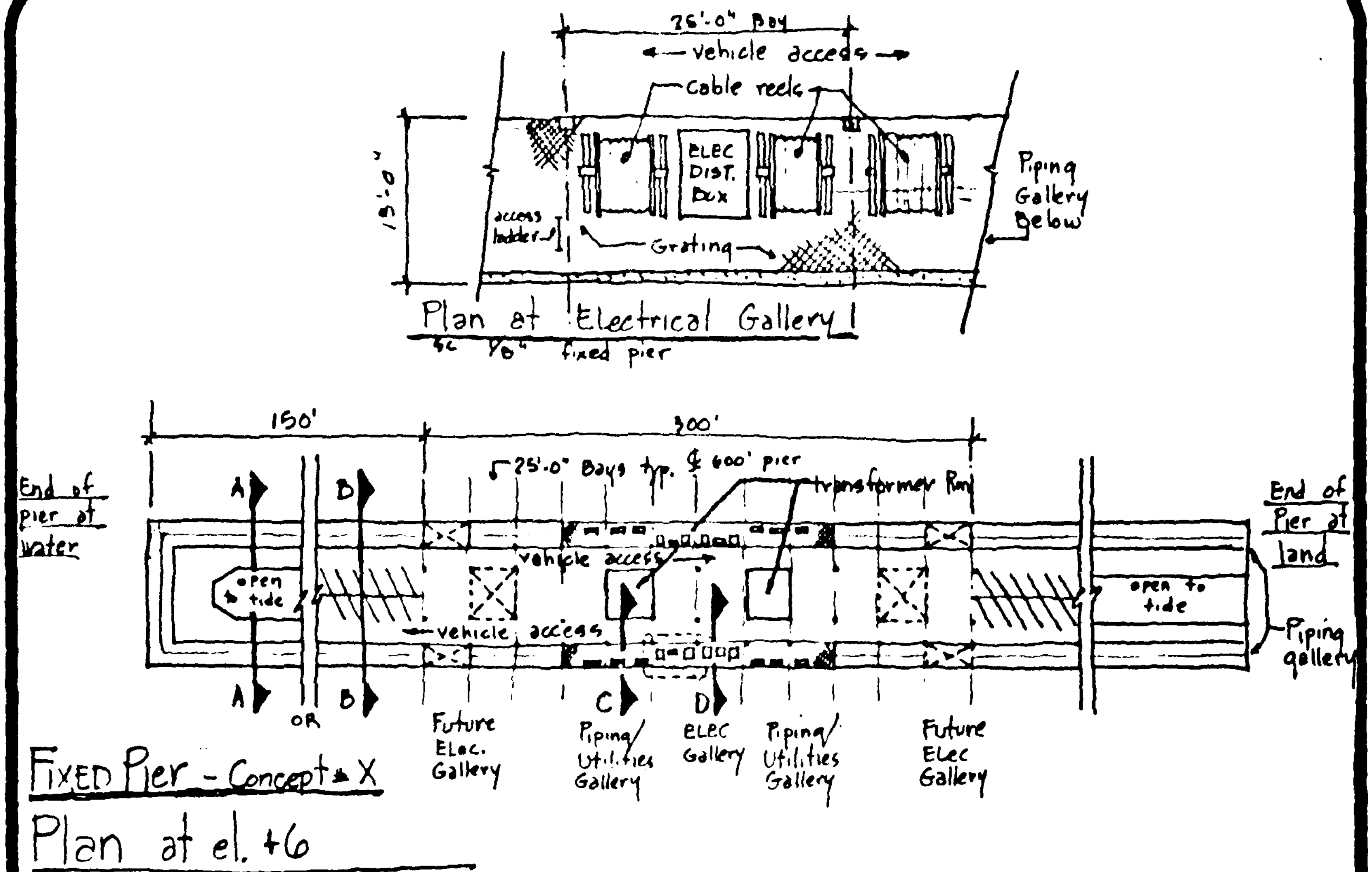

25'-0" Bay
vehicle access
cable reels
ELEC DIST. Box
Piping Gallery Below
15'-0"
access ladder
Grating
Plan at Electrical Gallery
sc 1/8" fixed pier
150'
300'
25'-0" Bays typ. ℄ 600' pier
transformer Rm
End of pier at water
End of Pier at land
open to tide
vehicle access
Piping gallery
A
B
OR
C
D
Future Elec. Gallery
Piping/ Utilities Gallery
ELEC Gallery
FIXED Pier - Concept X
Plan at el. +6

FIGURE B-31

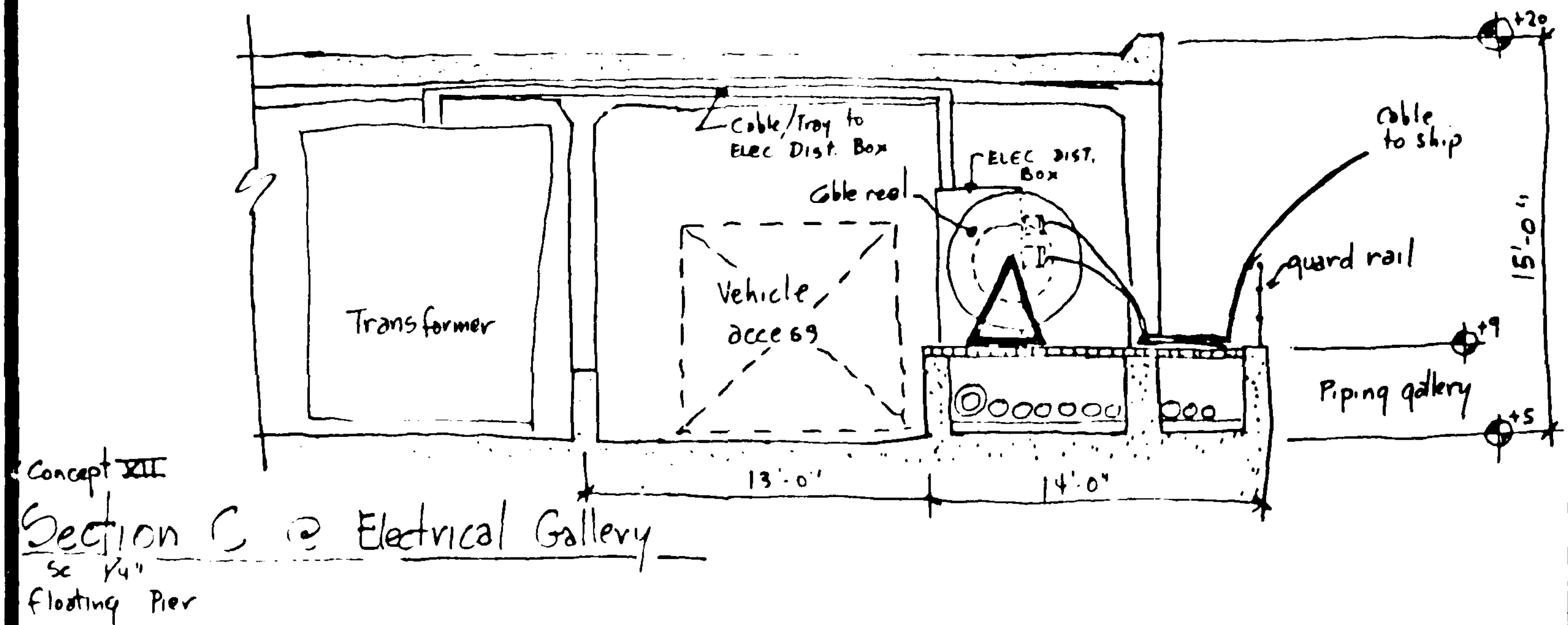
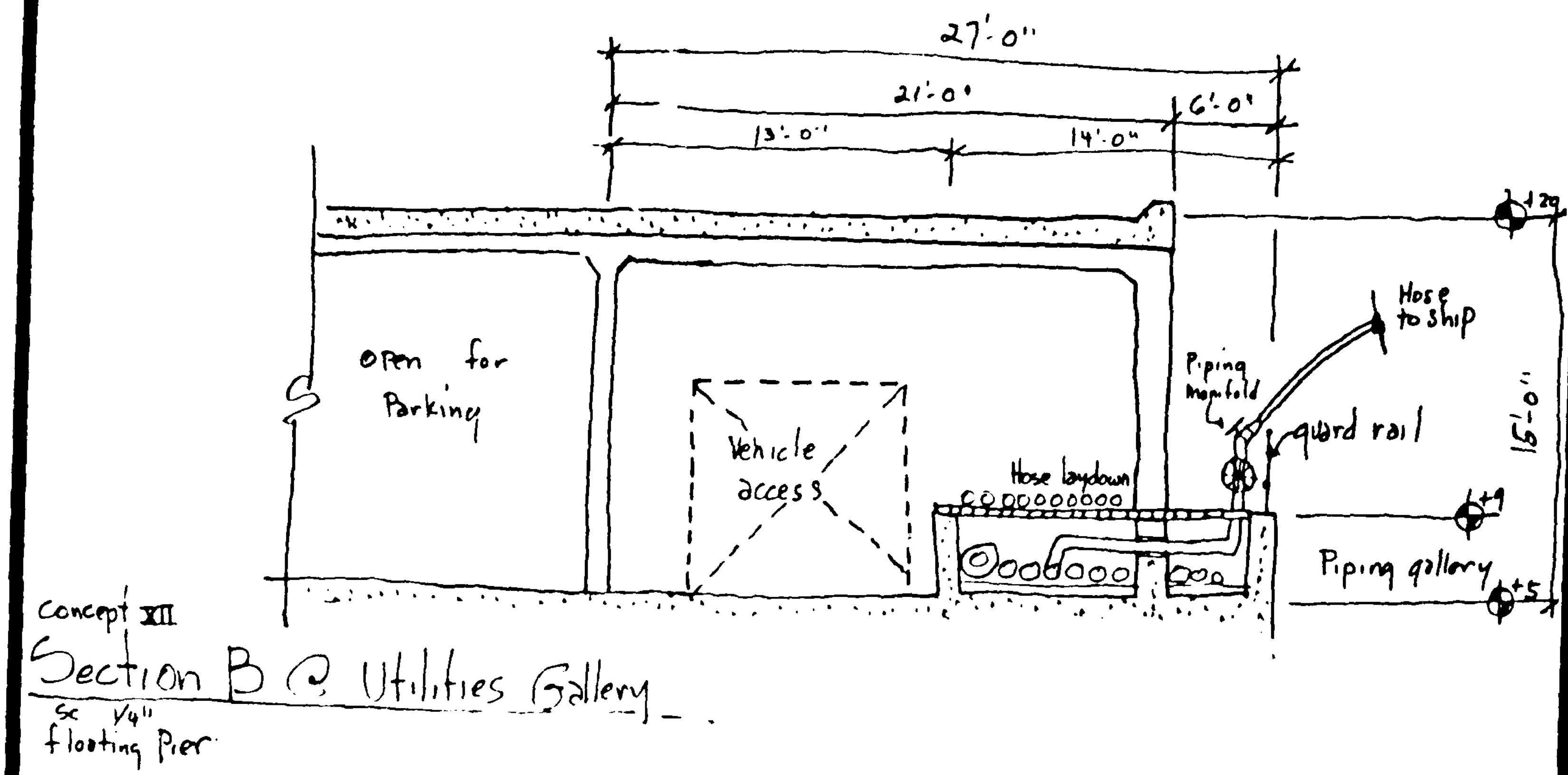

Cable/Tray to Elec Dist. Box
ELEC DIST. Box
Cable reel
Cable to ship
guard rail
Transformer
Vehicle access
Piping gallery
+20
+9
+5
15'-0"
13'-0"
14'-0"
Concept XII
Section C @ Electrical Gallery
Sc 1/4"
Floating Pier

FIGURE B-32



27'-0"
21'-0"
6'-0"
13'-0"
14'-0"
Open for Parking
Vehicle access
Hose laydown
Piping manifold
Hose to ship
guard rail
15'-0"
+20
+9
+5
Piping gallery
Concept XII
Section B @ Utilities Gallery
Sc 1/4"
floating Pier

FIGURE B-33

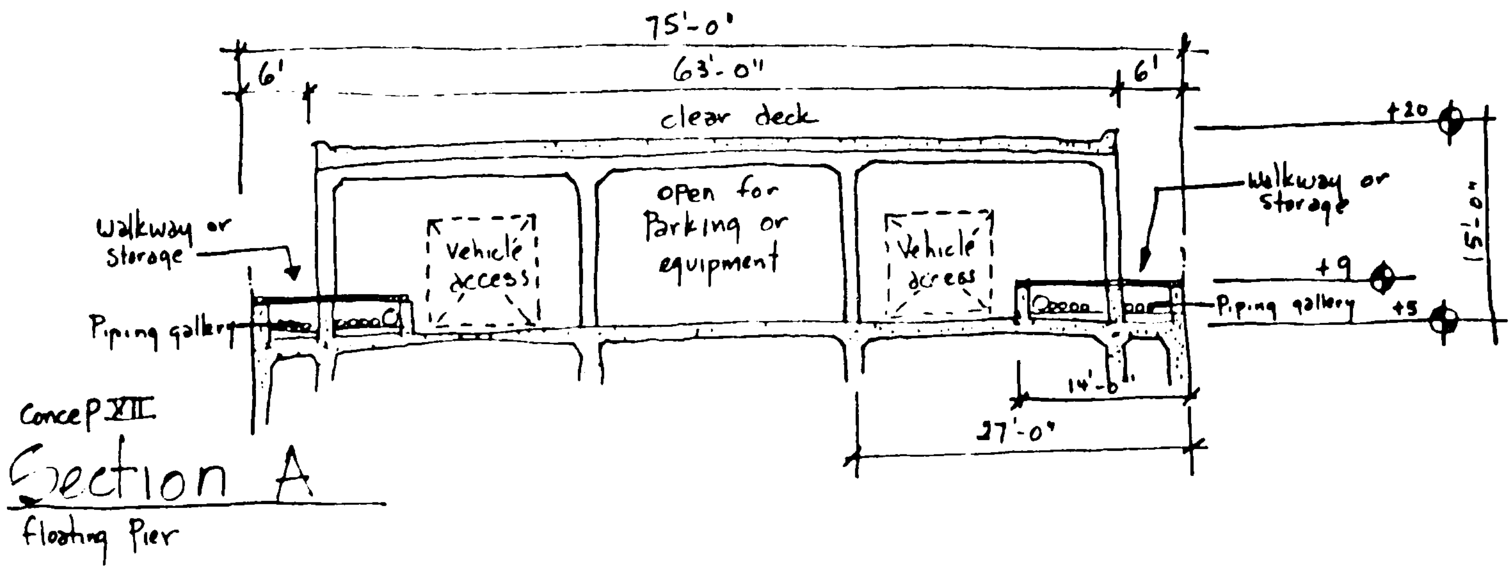

75'-0"
6'
63'-0"
6'
clear deck
open for
Parking or
equipment
Vehicle
access
Vehicle
access
Walkway or
Storage
Walkway or
Storage
Piping gallery
Piping gallery
+20
+9
+5
15'-0"
14'-6"
27'-0"
ConceP XII
Section A
Floating Pier

FIGURE B-34

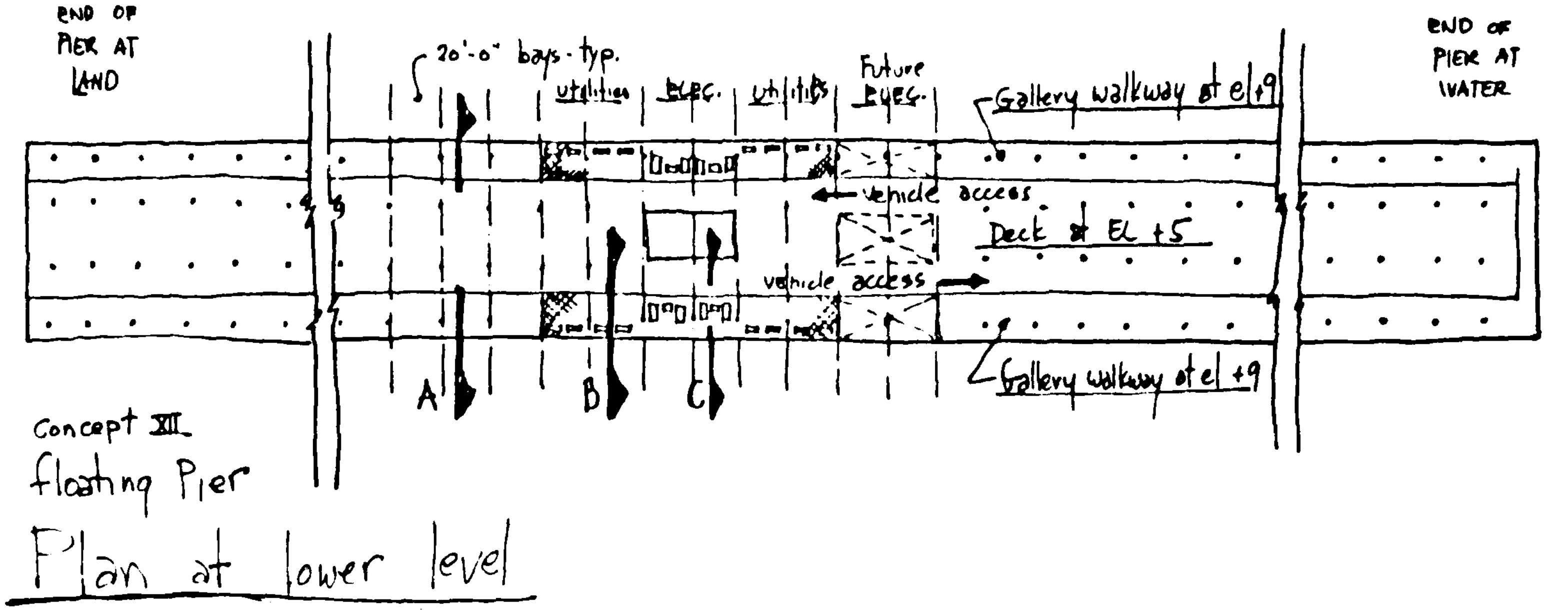
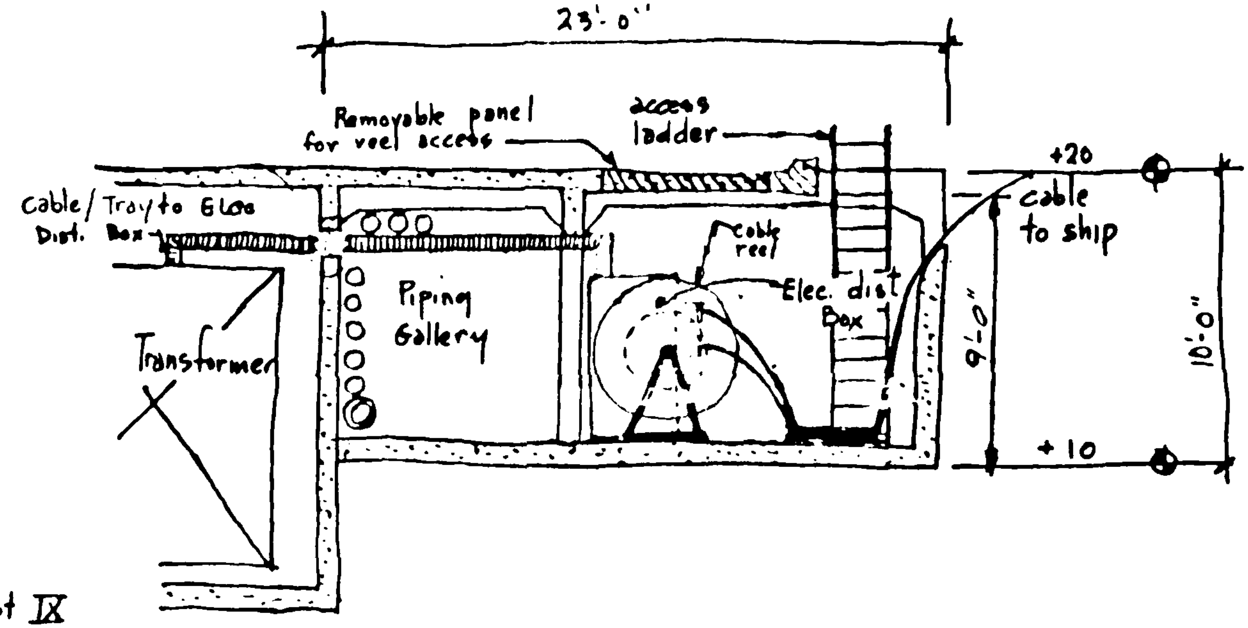
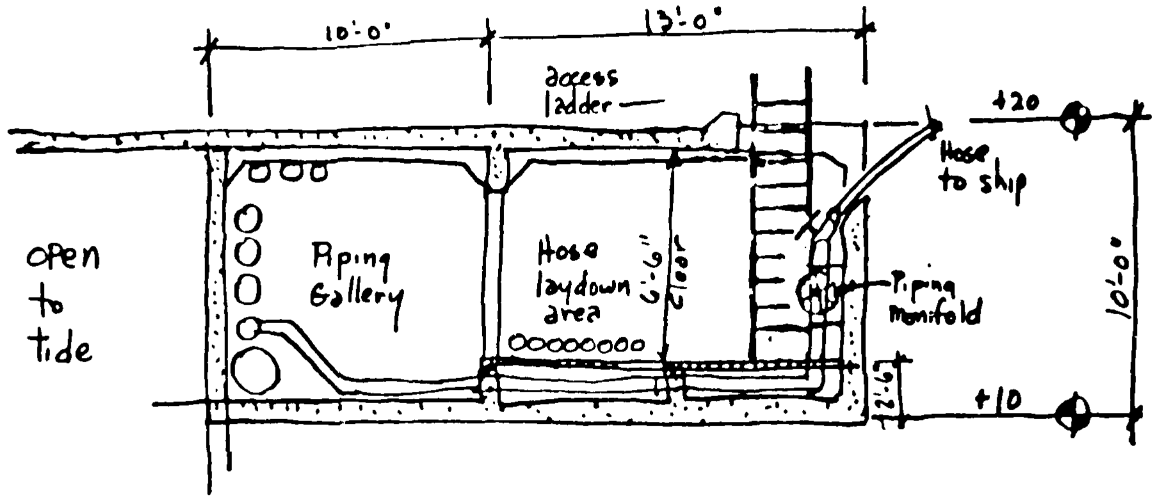

END OF
PIER AT
LAND
20'-0" bays - typ.
utilities
ELEC.
utilities
Future
ELEC.
Gallery walkway at el +9
END OF
PIER AT
WATER
vehicle access
Deck at EL +5
vehicle access
A
B
C
Gallery walkway at el +9
Concept XII
floating Pier
Plan at lower level

FIGURE B-35



Concept IX
Section at ELECTRICAL Gallery
SC 1/4"

FIGURE B-36



Concept IX
Section at Piping Gallery
sc 1/4"

Concept # IX - FIXED Pier
without vehicular access

FIGURE B-37

APPENDIX C

MINUTES OF MEETINGS/TRIP REPORT

- MINUTES OF MEETING - PRELIMINARY CONFERENCE
- TRIP REPORT - ON-SITE OBSERVATIONS AT NAVAL STATION, SAN DIEGO, CALIFORNIA
- MINUTES OF MEETING - PUBLIC WORKS OFFICE, U. S. NAVAL STATION, SAN DIEGO, CALIFORNIA
- MINUTES OF MEETING - CABLE REEL MANUFACTURER CONFERENCE

MINUTES OF MEETINGS

Recorded by: John F. Hamer

Recorded: October 22, 1982

Project:	Engineering Services for Navy Pier Facilities and Related Tasks
U.S.N. Contract No.:	N62474-82-C-8303
BARDI Project No.:	XF-0025
Place:	N.C.E.L., Port Hueneme
Date:	October 12, 1982
Time:	9:00 a.m. - 2:00 p.m.
Purpose:	Preliminary Conference
Attendees:	Duane Davis N.C.E.L. Doug Dahl Bob Julian John Norbutas Pete Tafoya Tom Burton V.S.E. CORP. George Gardiner Bob Hansen John Hamer BARDI Oscar LaCour John Pratt, Jr.

The following is our understanding of the significant points covered, statements made and decisions reached during the meeting.

- BARDI submitted the following documents, a copy of each of which is appendixed to these minutes.

  - Project Approach (3 pages)
  - Schedule for Completion (1 page)
  - Project Schedule (1 page)
  - Questions (1 page)

- The project approach was read aloud and discussed.

- The effective date of the contract is September 30, 1982. This date was used for the calculation of the dates shown on the "Schedule of Completion" and those dates were therefore, confirmed as correct.

- The project schedule was presented without comment.

- The question period then proceeded with extended discussion, the essential results of which are presented in the following statements.

- The prime needs of this Task No. 1 study in order to best serve NCEL is, as per the scope of work, essentially to identify the method of bringing utilities onto the pier in a gallery (s), size the gallery (s), and present the best way of providing utility stations. Proper levels of lighting and appropriate methods of lighting is the second sub-task. This task should remain simple and within the bounds of the budgetted hours.

- The T.Y. Lin report may be considered an example of the type and format of report desired by NCEL. The scope of the Lin study was of course considerably larger than BARDI's study.

- The distinction between an "open" and "closed" gallery concept is dependent upon the degree of direct access to the utility corridor along the pier. If the openings for ship to shore utility line egress is essentially continuous along the majority of the length of the pier (allowing for structural members to distribute bollard loads etc.), the gallery is said to be "open". If the openings for ship to shore utility line egress is restricted to more localized locations (near the utility stations), then the gallery is considered to be "closed". The floating pier concept depicted by T.Y. Lin was considered to have "open" galleries, while the fixed pier concept depicted by S.M. Johnson was considered to have "closed" ones. An evaluation of both "open" and 'closed" concepts is within the scope of work of this study.

- NCEL is presently studying an in-house developed crane for use in handling utility hoses and cables. Presumably a davit-type, cherry-picker type combination, such a crane could serve well for utility openings which would allow vertical egress of lines from the gallery.

- Loading arms are presently used by the Navy for both fuel oil ar J in some instances for electrical connections.

- Vehicular access along the lower deck is presently planned for both the generalized floating pier concept by T.Y. Lin, and the Scheme E concept proposed for Pier Zulu at Charleston by Gee & Jenson. This access is for trash collection, cargo transfer, maintenance, and other possible functions.

- Although the "Ship Requirements Data and Pier Design Criteria" document does not list the CGN-38 class of ships and that various other items are not complete for the other classes, the document is the best available at the present time. Although NCEL is currently engaged in expanding the document, BARDI should proceed with the study using it as it now exists as basis for design criteria.

- BARDI should make the selection of utility groupings based upon "Ship Requirement Data and Pier Design Criteria" document, plus the diagram depicting those service locations presented as figure 10 in the Concept Study for the Berthing Pier (Pier Zulu) at Charleston, S.C., as prepared by Gee & Jenson.

- The width of Navy Piers generally varies from approximately 75 feet to 100 feet. The Zulu Pier at Charleston will be 76 feet. The width is not intended as restraining criteria if it is found that, considering all costs involved, the piers should be of more generous proportions to best accommodate the utilities and serve all other needed functions most economically.

- The pier elevation of +16 as shown in our scope of work will be changed to Elev. +20.

- For any disparities of utility requirements defined in the "Statement of Work" and the "Ship Requirement Data and Pier Design Criteria", the "Ship Requirement Data and Pier Design Criteria" document takes procedence.

- Nesting is to be provided for. One nested vessel will be given specific accommodation, while more than one may be provided for with reduced services/pressures etc. and through spare connections which might be provided. For design purposes each pier shall accommodate a maximum of 8 ships.

- One berth will be dedicated for a tender berth.

- The utilities listing in the scope of work should include two (2) 8 inch fuel oil lines (one for JP-5, one for DFM), rather than one (1), and one (1) future condensate line.

- No boiler makeup water is needed, since ship condensate is used for that.

- No nuclear water makeup required for CGN-38. BARDI is to consider all other mechanical and electrical requirements for the "Work Statement".

- The Salt Water System is used for both Fire and Housekeeping.

- Salt water pressure varies - separate regulators may need to be provided for each station.

- Steam pressure of 150 PSI is okay.

- Oily waste and sewage must be sloped to drain. NCEL will provide information on what is now used to prevent one craft pumping into another when discharging.

- Sewage hose to be non-collapsible as specified in Statement of Work.

- All sewage is pumped off of piers. No vacuum trucks are used.

- NCEL does not see future uses of piers to include hydrocarbon fuels handling of low flash point materials which demands the installation of explosion proof equipment on piers.

- An apparent electrical criteria descrepancy exists in that the "Ship Requirement Data and Pier Design Criteria" called for 15,000 amps to be provided to the tender but that the total shore power cables including feed through circuits could only carry 11,200 amps per side. N.C.E.L. will verify proper requirement and notify BARDI.

- The requirement for 4,800 amps to supplied to a DD 963 class ship appears to be excessive. N.C.E.L. has been pursuing verification of this requirement.

- Ship requirements data and pier design criteria for the CGN 38 is presently not available. NCEL will furnish data as it becomes available.

- Electrical power requirements do not seem to be met by the number of cables called out in the criteria.

- NCEL will provide the low voltage power cable specification.

- NCEL will provide a list of standard power distribution transformers with 480 volt 3 phase secondaries.

- Elemination of the storage of cable on the pier deck is essential. Ventilation of galleries and electrical vaults is needed, but neither must be pressurized since the handling of hydrocarbon fuels of low flash point is not foreseen.

- Telephone, communications and training cables will be provided.

- The facilities being considered in this contract are for use within the continental United States. Therefore, freeze protection should be considered with regard to the northerly limits of the U.S., similarly, tropical conditions beyond the southerly limits of the U.S. need not be considered.

- Cost estimating data as referred to in the scope of work refers to only those unusual situations where typical A-E designers may require guidance for items beyond their normal estimating practices.

- NCEL provided BARDI with one copy of Electrical Engineering-Electrical Utilization Systems Design Manual-4.4.

- DM 25 is not published as yet.

- Manuals (DM 3, 4, etc.) may be obtained from:

  Mr. Robert Carlton
  NAVFAC Headquarters
  Arlington, VA

- Received copies of "Proceeding of the Workshop on Pier Design for the Fleets of the 1990's and beyond", hosted by NCEL at Port Hueneme 22-26 February, 1981.

- BARDI reviewed the set of construction drawings for Pier 2, Naval Station, San Diego, CA. prepared by Ferver Engineering Co., and selected certain drawings they desired a print of.

- BARDI stated their intention to take light level readings on one or more piers during the site visit at San Diego Naval Station.

- Monthly project reports should be sent to the officer in charge of Contracts as identified in the contract.

- No special invoicing forms are required. The invoice should include the contract number (N62474-82-C-8303), the date of invoice, BARDI invoice number, amount of billing, and task number identification. It should be mailed to the contracts officer as indicated in the contract, attention code L23.

Recorded by: John F. Hamer

Brown & Root Development Inc.

October 22, 1982

ON-SITE OBSERVATIONS

AT NAVAL STATION, SAN DIEGO, CALIFORNIA

Recorded by: John F. Hamer
Recorded: October 22, 1982

Project:	Engineering Services for Navy Pier Facilities and Related Tasks
U.S.N. Contract No.:	N62474-82-C-8303
BARDI Project No.:	XF-0025
Place:	U.S. Naval Station San Diego, CA
Date:	October 13-14, 1982
Purpose:	To perform on-site observations of utility systems, vessel connections, and lighting fixtures and illumination levels.
Attendees:	Chief Petty Officer-Tyson - Staff Civil Engineering
	Duane Davis - N.C.E.L. - Part Time
	John Hamer - BARDI
	Oscar LaCour - "
	John Pratt - "
	Joseph Adkins - "

The following is a list of some of the on-site observations made during tour of piers at San Diego Naval Station, San Diego, California.

- During the two days of the on-site observations at the Naval Station, San Diego, piers 2, 3, 5, 7 and 8 were visited. Berthing operational procedures were observed, utility runs in tunnels observed, an under-pier transformer vault was entered, utility connection/disconnection operations witnessed, and a ship departure and berthing operation witnessed.

- The following was observed concerning the cables carrying power from the pier to the ships:

  . The complete cable used to connect the ship's shore power panel to the pier panel is made up of two parts. One part has a receptacle on one end which connects to the pier panel and has pig tail connections on the other end. The second part of the cable has a receptacle on one end which connects to the ship's panel and pig tail connections on the other end. The pig tail connections of each part are bolted together to form a complete cable.

  . Excess lengths of cables supplying power to moored ships as well as unused cables were left lying alongside the edges of the pier.

  . Cables were manually hauled up the sides of the ships with lines, sometimes over life lines, to the shipboard shore power box.

- The following was observe concerning hoses supplying mechanical services from the pier to ships:

  . Collapsible hose was used exclusively for potable water, salt water and sewage services for the ships moored alongside the piers. For storage, each line was flattened and rolled into coils. And tied off for easier handling.

  . There were no fueling facilities on or under any of the piers toured.

- The following was observed concerning the utility installations on the piers:

  . On pier 2, steel pipe, and not Asbestos Cement was used for the fresh water service.

  . On pier 2, no slope was observed on sanitary sewage gravity drain in section of pier inspected.

  . Unidentified and unconnected 12"Ø Class 250 flanged line in tunnel on pier 2. Covers cast in concrete for future connection. Contract drawings for the services prepared by Ferver Engineering Co., indicate it to be a ships waste water line (usused), but no slope is indicated for gravity drainage.

. All piping observed on Piers 2 and 7, except for sewage, appeared to be looped.

. Steam Lines outside of curb and bollards, but inside of fendering on both 2 and 7.

- The following was observed concerning transformers:

  . The transformer vault below the deck of pier No. 2 is approximately 90' long, 27' wide and 17' high and contains the following items:

    - Two 5250 KVA, 12 KV/.48 KV transformers
    - 12 KV switches, one per transformer
    - 480 V, 8000 amp bus duct, two per transformer
    - Vault sump pumps
    - Ventilation fans - intake and exhaust
    - Batteries
    - Breaker panels

  . Skid mounted load center found on pier 8 were approximately 37' long, 10' wide and 14' high and contained the following items:

    - One 5250 KVA, 12 KV/.48 KV transformer
    - One non-walkin 480 V switchgear with 20 current limiting fuse protected circuit breakers.
    - Twenty integral deck mounted receptacles.

- The following was observed concerning pier illumination:

  . On the night of October 14, 1982, observations of the illumination levels on the piers were made. The sole source of permanent lighting on all of the piers was by shaded curb lights located at approximately 50 foot intervals along both sides of the piers. Additional temporary lighting was provided by ships moored alongside the piers with shipboard lights located approximately 20 to 40 feet above the pier deck. The light pattern from the shipboard lights was random, providing several relatively brighter and darker areas. The light pattern from the curb fixtures formed a small fan shaped configuration.

  Illumination levels were measured on piers 2 and 3, using a WESTON PHOTRONIC model G 19 light meter calibrated for direct reading in foot-candles, and corrected for cosine response. Readings made of the curb lighting on pier 2 ranged from 50-60 foot candles within 6 inches of the source, and fell off to 10-20 foot-candles within two feet. At five feet from the source, no reading was detectable. On pier 3, curb light readings ranged from 20-30 foot-candles at 6 inches, fell off to 10 foot-candles at two feet, and again, no discernable reading at five feet.

- The temporary lighting mounted aboard ship provided a level which measured less than 5 foot-candles at the brightest spots along the piers.

- Gangways were lighted with self contained rows of small lamps.

- Both pier and ship light sources were incandescent lamps which rendered a light spectrum of good color quality.

- The night the observations were made, the weather conditions were ideal; the sky was clear and the temperature approximately 70° F. The pier was generally free of surface obstructions, however, where obstructions did exist they were marginally illuminated so as not to be a trip hazard to pedestrain traffic. Under adverse weather elements such as rain, snow, fog and icing, a modest lighting system such as seen might be rendered to be below safe light levels.

- All of the piers on the station were observed and all were found to have illumination levels essentially the same as piers 2 and 3.

- The support provided by Mr. Duane Davis of NCEL and by Chief Tyson of the Naval Station to BARDI personnel during the two days spend touring the piers at San Diego Naval Station was outstanding and very much appreciated.

MINUTES OF MEETING

Recorded by: John F. Hamer

Recorded. October 22, 1982

Project:	Engineering Services for Navy Pier Facilities and Related Tasks
U.S.N. Contract No.:	N62474-82-C-8303
BARDI Project No.:	XF-0025
Place:	U.S. Naval Station San Diego, CA Public Works Office
Date:	October 14, 1982
Time:	9:00 a.m. - 10:00 a.m.
Purpose:	Information Gathering
Attendees:	C. E. Davis - U.S.N. Public Works Duane Davis - N.C.E.L. John Hamer - BARDI Oscar LaCour - " John Pratt - " Joseph Adkins - "

The following is our understanding of the significant points, comments and statements made during the meeting.

- Mr. Davis would not put a mechanical system under the pier or below water level.

- Mr. Davis also would not put the steam system below deck.

- Fresh water is tied into ships system for direct usage. It is not used for boiler makeup; it may be that a later requirement would be for a demineralizer.

- Salt water pipe pressure has been a problem. Regulators were tried unsuccessfully, then bleeds, then variable speed Salt Water Pumps, none of which have been too satisfactory. They feel the latter, which is still being tested, is most promising of the 3.

- Steam is provided at 150 PSIG. It was necessary to regulate to 90 PSIG at one time, but the ship's piping design was upgraded to 150 PSIG.

- Compressed air is provided at 100 PSIG.

- Piers 1 and 2 sewage is gravity drain to shore. Piers 3, 4, 5, 6 and 8 are gravity drain to lift stations on pier. Pier 7, the newest and still under construction, is gravity drain back to the city lift station which is at a low elevation.

- Sewage collection should probably be by gravity to several small holding tanks along the pier, from which ejectors or pumps transport it through pressure lines to the Naval Base's gravity collection system.

- Check valves at ship's sewage pump discharge adequately prevent over-pressuring of one ship's system when another ship is pumping out.

- Slope required on gravity drain of sewage is similar to house plumbing requirements.

- No oily waste removal is provided for. Bilge water removal is provided for at North Island, and will be required at submarine piers in the future.

- Asbestos Cement Piping is used for fresh water.

- Wrapped steel piping is used for compressed air.

- Steam piping is steel, insulated, and jacketed, with a gap inside the outer jacket.

- Cast Iron Piping is used for Sewage.

- Non-collapsing hose for sewage services is difficult to handle. It was tried and discontinued.

- The use of San Diego Naval Station's berthing facilities for ship repair activities has been steadily increasing over the years, conversely the number of ships requiring just hotel services is decreasing.

- The electrical load requirement of the ships berthed at the Naval Station piers has been steadily increasing whereas the other utility services required by the ships have changed very little.

- Contractors' use of the pier dock space has generally usurped the space available for other purpose.

- On pier parking is a continuing problem.

- The ideal pier width would be 100' if access was properly controlled and no personnel parking allowed on the pier.

- Only compressed air, steam, salt water, potable water and sewage mechanical services are provided.

- If fuel is required, a fuel barge is brought around.

- Fuel loading arms have been used elsewhere, ie. Hawaii, Connecticut, etc. but not in San Diego, CA.

- Piers 6 and 8 have shallow utility tunnels, with steam lines carried in the tunnels, which have brought on condensation, rusting, etc., and the need to shut the steam system down in order to put people in the tunnel to make other repairs.

- Steam lines in galleries have proved in general to be a problem for maintenance operations. After various alternatives were tried, a standard was developed in which the steam line is located just inboard of the fender whaler on a recessed concrete shelf projecting just outside the curb line.

- Piers 2 and 7 are the newest piers on the base; Pier 2 is an improvement in design. Both have underwater electrical vaults, the lower portion of which is below water level.

- Steam Lines were located outside of the curb and bollards, but inside of the fendering on both Piers 7 and 2.

- Pier 2 uses a reserved "corridor" along each side of the pier deck for utility services and lay down of utility lines and cables. Lay down of other than utility items is also frequently experienced, within this "restricted" corridor. This corridor also requires a crane with a longer reach to access berthed vessels.

- The standard length of the electrical cables used for ship to shore connectors is 125 feet.

- The cable designation is 3/C - 500 MCM Copper, rated at 400 Amperes.
- Bolted connections are used, being favored over plugs and receptacles, which have proved to be troublesome.
- Ship personnel haul the cable aboard the vessels, but base personnel makeup the cables and energize the service.
- When more power is required than the pier transformers can supply, additional portable load centers are towed to site and utilized.
- Power is not metered at each load center.
- Individual ship requirements are not metered.
- Cables not in use, or planned for early re-use are not stored on the piers, rather they are transported to store houses in the back area of the base.
- Mr. D. E. Davis stated that when top side pier tasks are performed after dusk which require a higher light level than is normal on a pier, temporary lighting fixtures are supplied by the Naval Base and rigged to yield a temporary lighting system adequate for the task.

MINUTES OF MEETING

PLACE: 1750 Townhurst, Houston, Texas

PURPOSE: Discuss Cable Reels

DATE: December 1, 1982

ATTENDEES: J. R. Woodruff - Owner Woodruff Co.
Palmer - Woodruff Salesman
R. J. Caesar - Vice President-Marketing Gleason Reel Co.
R. A. Hurst - Western Regional Manager Gleason Reel Co.
O. O. LaCour - Brown & Root, Inc.

Discussion revolved around two points, i.e.,

1. 125' long - 3/C - 500 MCM - 600 Volt rated cable - type THOR-500 terminated with 9" diameter plugs-both end and

2. Cable reel of these approximate dimensions - drum 42" diameter - 60" long - flange 60" diameter - powered with break to accommodate a minimum of 5 cables as described in (1) above

   A) This reel has probably never been built.

   B) All the known required reel/break/power drive features have been engineered/built previously but not as a unit having these dimensions.

   C) There is no reason to presume that such a reel in the service as described would encounter serious problems.

   D) The 60" diameter reel flange may be a little shy to accommodate 625' or cable with plugs.

   E) Reel must be powered for reeling and unreeling.

   F) A clutch is desirable and perhaps mandatory.

   G) Reel must be securely anchored-if it ever became freewheeling it could and would be dangerous.

   H) Rollers are probably necessary for laying the cable up on the drum.

   I) Partition flanges segregating the 60" long spool would aid in reeling the cable lengths.

   J) The assumed area of potential problems and/or unknowns is the impact arising from the cable plugs. The cable will reel very irregularly on the drum resulting in poor reel volume utilization.

K) It is possible that consideration may wish to be given to a single reel power drive arranged to drive multiple reels.

L) For reels to perform at their best the cable or rope to be reeled and unreeled must be controlled by restraints which maintain a tension on the cable. Slack on the cable will result in the equivalent of "back cash". Also the cable will lay up on the drum in a random lay with many crossovers.

M) Cable kinking is not likely to be a problem because the cable is short in length and the cable laid out and free to recieve stresses developed in the cable due to previous reeling/unreeling.

N) No one present had any knowledge of the reels now in service aboard destroyer tender vessels. Mr. Hurst agreed to look into the matter.

LME

— 8